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# GAS FITTING

# GAS FITTING

## A PRACTICAL HANDBOOK TREATING OF EVERY DESCRIPTION OF GAS LAYING AND FITTING

By JOHN BLACK

SECOND EDITION, ENLARGED

With One Hundred and Thirty-one Illustrations

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# PREFACE.

A BRIEF introduction only is needed for this little work, since it lays no claim to any high literary pretensions. We have endeavoured, in clear and simple language, to go through the practical details of a handicraft on which, we believe, no handbook has yet been published. Fragmentary allusions to various methods, occasional receipts or wrinkles which are useful to a gas-fitter, have appeared in trade and general journals from time to time, but there has, no doubt, been felt by many a need of a practical treatise dealing in a consecutive form with the operations of gas-fitting.

There is little fear that the work of the gas-fitter will, in our generation, as some would have us think, pass out of ordinary requirements, for gas as a household illuminant still holds its own, more firmly rooted in favour than before, since the eccentricities of household electric lighting have come to be known. The gas-fitter is in as great request to-day as at any time since the introduction of this cheap, convenient, and pre-eminently comfortable light. There is even more occasion now for the display of intelligence and skill than at any other period in its history; for new methods are day by day invented and developed with which the gas-fitter must be familiar; but he must also cling somewhat closely to the traditions of his craft, for many of these novelties are but for a moment, while his skill, often learned by slow and painful steps, is something that remains in his possession always.

It may truly be said that scarcely any handicraft has stood in greater need of a handbook, since the methods and details are many and varied, and those old hands whose experience has taught them much of their trade are most reticent in imparting their knowledge to a beginner. It is hoped, however, that throughout these pages many a hint may be gathered to supplement the observation even of journeymen long accustomed to the trade, as the information has been gathered from many sources, and the methods and appliances recommended tested by actual experience.

## ADVERTISEMENT TO SECOND EDITION.

The present is substantially a reprint of the First edition; but a Supplementary Chapter has been added, giving a brief account of recent improvements in Burners and of the new Incandescent systems, as also of Penny-in-the-slot Meters, and other modern developments of Gas-lighting.

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# GAS FITTING.

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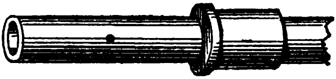
In service laying, which is really at the beginning of our subject, we may mention that, as a general rule, there are two systems in ordinary use, namely, iron and lead services, and it is almost superfluous to remark that, under certain circumstances, each has its advantages and disadvantages, its advocates and its detractors. So prevalent is the practice of laying iron services, these being adopted by all the leading gas companies of England, that it may be thought that the description of lead services, which are chiefly in use on the Continent, might be superfluous. Cases may, however, arise where a knowledge of the methods used in laying both systems is useful; we therefore give particulars of service laying in both iron and lead. Under other circumstances, as for instance, where the pipes are laid in "made ground," the lead service is the better; but in places where dampness prevails, or where, by means of chemical influences, corrosion may be set up, then undoubtedly the iron piping is the best, owing to its non-liability to decay. Iron services, it is almost needless to remark, last much longer than their softer and more pliable rivals, while under some favourable situations they have been known to exist in good condition for a very long period. Much, of course, depends upon the situation, description of ground, &c., and also a great deal upon the protection given to the pipes. Thus, where the ground is made, the lead service, supposing it is properly protected so as to resist atmospheric and other influences, is undoubtedly the best; but in the laying down of services so much is regulated by local circumstances that it is impossible to give here hard and fast rules. We shall have to return to this subject of iron *versus* lead piping later on in our volume, as, for instance, when giving instructions for overcoming the difficulties incidental to the connecting of meters with lead services: we shall, therefore now, for the sake of brevity, deal only with the laying of the iron system.

Assuming the main to be uncovered, the necessary ground got out, and the required hole in the wall made by the gas-fitter or service-layer (in some places, we may mention, the gas companies do not lay their own services, but have the work contracted for by outsiders), as the case may be, the first thing to be done is to cut the hole required for the service pipe, which can be effected in either of two ways: by means of the cutting-punch or by drilling. The former is by far the quicker method, but its drawback is that it leaves a rough and ragged hole, and consequently the tap which is afterwards used will not cut a uniform thread. Although we do not recommend the use of the cutting-punch, still we shall give the method for making holes by its means. Thus, the fitter or other operative first dots his pipe—in this case iron—with the centre-punch (Fig. 1), and then, by means of a pair of compasses, strikes a line of the exact diameter of the hole which he is desirous of making, having previously chalked the pipe in order to make the hole show up distinctly. Here it may be remarked that many service-layers, owing to extensive practice, dispense with the compasses for striking the line, but it is always advisable to employ them, and for amateurs especially we commend their use. The operator then dots the line round at intervals of about ⅛ of an inch, as shown in Fig. 2, so that in case the line gets at all obscured, there is still a guide left by which to work. The hole made by the punch should always be just a trifle smaller than intended for tapping, owing to its having, before this operation, to be cleaned out by a rimer. The cutting-punch is made round-nosed, and an illustration of it is given at Fig. 3. The cutting of the hole in the pipe having been effected with the before-mentioned tool, the orifice must be well rimered out with a six-square rimer and key, similar to those illustrated in Figs. 4 and 5. The rimer is a very easily constructed tool, and must be well tempered, and though the job is negotiable by an intelligent and handy amateur, still it is preferable to have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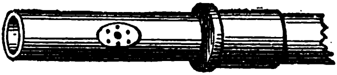
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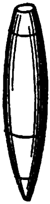
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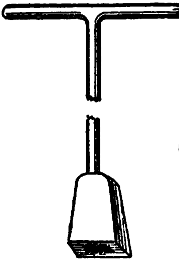
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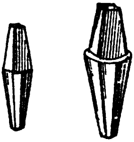


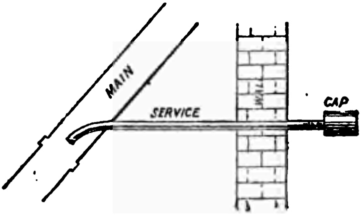
Fig. 5.

the articles made by a first-class tool manufacturer, bearing which in mind, we shall not give a lengthy description of the apparatus. When the hole has been rimered out, which should only be done so far as to just permit of the point of the tap entering, tap it down until a full and perfect thread is obtained, but care must be exercised in order to prevent it becoming too large. The service-layer or fitter should never, under any circumstances, allow a bad thread to be put in a service pipe for a main, as above all things the joint should be made quite sound in all respects.

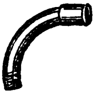
As may readily be imagined, these lines have not been penned in the interest of the gas companies, but we must fain confess that more accidents have arisen through the inefficient laying of service pipes than from any other cause in which gas has been a factor.

To proceed, however, with the work in hand: the operative, after tapping the outlet-hole, must get the length as accurately as possible, leaving about 4 inches of the service pipe through the wall.

Here we must, with the reader's permission, make a slight digression, to remind the gas-fitter especially that under no circumstances whatever must a service be taken anywhere else than into a cellar of a house, and care must also be exercised that the pipe is not laid level, but that it should have either a fall to the main or the meter. Of course instances will at times occur where it is impossible to procure for the service a direct fall to either the main or the meter, and in these cases the fall must be given below the meter, and a syphon then put in, the method of doing which will be treated of at length when we explain the modes of meter fixing. Presuming, however, that the novice has got the length of service accurately, a bend must now be screwed into a hole in the main, of course previously stopping the end with a little tow to prevent the unavoidable escape of gas from the main, which should then be connected by means of a length of pipe with a cap on the end of the service to the spot where the meter is to be placed, thus:—



Should the service fall to the main, it will be necessary to have an open bend; but if it falls to the meter a close bend will be required, as illustrated in Figs. 6 and 7; but in case the bend should not answer exactly to the layer's requirements, it can be very easily altered so as to make either a close or an open bend, by being heated in a fire, care of course being taken in bending not to close or draw the pipe. In bending iron pipe the best way is to mark it with chalk where it is desired to make the bend, and then heat it to a fair red heat for a distance of about 2 inches on each side of the chalk mark, where the fire will not remove it; the pipe must then be cooled with water, about 1 inch on each side of the chalk mark being left red hot. Then take the piping and screw it lightly—caution must be exercised in this—lengthwise in a vice, so as to prevent the pipe rinking, and then, with the help of an attendant—a boy or labourer will do—a capital bend can be made of any pipes which do not exceed 1 inch; for larger than these other measures will have to be taken. The operator must be particular that he has the throw of his bend correctly, either to rise or fall, when he must proceed to connect up, not forgetting to thoroughly whitelead every socket and joint, so as to make all the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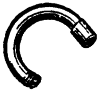
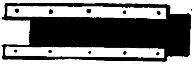


Fig. 7.

junctions thoroughly air-tight. In some of our larger towns the wise measure is taken of protecting all service pipes with coffin-wood, as illustrated at Figs. 8 and 9. Certainly this precaution should invariably be taken where lead services are employed.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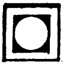


Fig. 9.

At times, when laying down service pipes, it becomes necessary to cut the main and fix in a T-piece. Although this portion of the work is, in reality, included in the duties of the main-layer, still it very often has to be done by the ordinary service-layer or fitter, and bearing this fact in mind, and also that the ordinary workman has often to perform the most unlikely of tasks, it will, we think, be quite as well if we give the method of doing the job. In all large towns it is usual for this work to be done with the gas on; and seeing that gas is very often required during the day in this very changeable climate of ours, especially during the winter months, and nearly all the year round for certain manufacturing businesses—such, for example, as printers, jewellers, hatters, and bookbinders, it will, in consequence, be necessary to keep a supply of gas on, while the main is cut and the service inserted. In such circumstances as these, it is customary to bladder the main. To give an instance, we will assume that the main is a 4-inch one, and that the service is needed for the supply of from 200 to 350 lights, when a service of not less than 3 inches will be necessary. In the first instance the workman must procure the T-piece, then a couple of bladders fitted with ⅜-inch cocks, and securely tied at the neck as illustrated at Fig. 12, a brass nipple being screwed on at the end of each, while a little taper union, illustrated at Fig. 13, must also be provided. These unions are constructed with a flange in the centre, and when secured with 1-inch, ¾-inch, or ½-inch pipe, according to requirements, must have a piece of ordinary lead piping, about 6 feet in length, fitted with unions, soldered on at each end as shown at Fig. 14. The workman must then take his T-piece (Fig. 10), and mark out with a piece of chalk the length of the piece which it is intended to cut off the main, say about 3 inches longer than the T-piece; then, at a distance of about 2 feet from each end of the main it is intended to cut, drill and tap two holes, afterwards stopping them with a form of plug similar to that shown at Fig. 15.

Next drill a couple of ½-inch holes about 7 or 8 inches nearer to the cutting lines, then tap them, and then roll up the two bladders as tightly as possible, afterwards inserting them in the before-mentioned ½-inch holes, and then inflate them, as depicted at Fig. 16. The operator must next blow in the tap, which effected, it should be turned off to prevent the air escaping. A gas-light stop must then be made at both ends of the pipe; then two brass nipples should be screwed into the 1-inch holes, and the lead connection, as shown at Fig. 14, screwed on to the nipples.

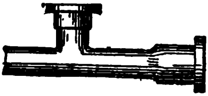


Fig. 10.

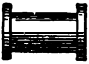


Fig. 11.

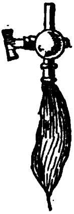


Fig. 12.

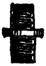


Fig. 13.

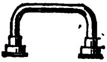


Fig. 14.

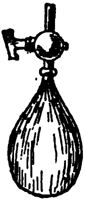


Fig. 16.

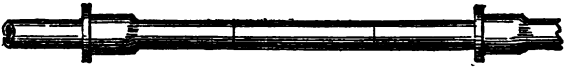


Fig. 15.

This being satisfactorily accomplished there will then be a sufficient supply of gas to answer all ordinary demands, and the piece of main can then be cut without the slightest danger to the workman, or with the least escape of gas. The complete operation is illustrated at Fig. 17.

The piece required for the purpose of laying the service will now need to be cut from the main, the round-nosed punch previously referred to being called in to effect this. To work, the workman cuts as deep a groove all round as he possibly can, when a few light blows from a sledge hammer on the part to be detached will usually effect the purpose without causing any damage to the remaining portion of the main. This being accomplished, the socket, as shown at Fig. 11, must be placed on one end of the main, sliding it back in order to get the T-piece in, afterwards sliding the socket back so that it covers the T-piece and the main an equal distance on each side of the main, the T-piece being as shown at Fig. 18. The next operation is the making-up of the joints with yarn, when about 1½ inches of each end of the socket must be left to enable the melted lead to be poured in, the workman, of course, first putting a "luting" of clay round the pipe in order to confine the molten lead to the joint, while it also serves in a measure to protect the workman. The leading being done, each of the joints must be well caulked, with tools similar to those depicted at Fig. 19. It is almost superfluous to remark that an unlimited number of joints can be made from T-pieces in the manner described, so long as the bladders are retained.

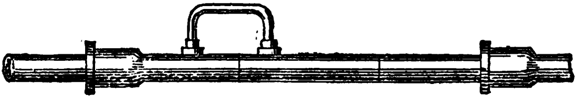


Fig. 17.

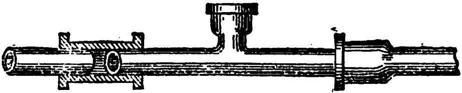


Fig. 18.

In accordance with our promise, we give here the method of drilling mains for service laying, in contradistinction to that of punch-cutting as noted above. In this the drill clutch, illustrated at Fig. 20, is the principal tool employed, having fixed which in position, drill with the ratchet brace, afterwards tapping the hole as before described. This system, though involving a little longer time, is by far the better method of cutting, the hole being clearly cut and easily tapped.

In the laying of leaden services the *modus operandi* differs but very slightly from that needed for iron pipes: the drilling of the hole and the fall to and from the main being precisely similar with both metals. Thus, the holes having been drilled and tapped, a nipple is screwed on and plugged with yarn to prevent the gas escaping; then a brass bend, fitted with a union (Fig. 21) and turned at one end, is soldered into the strong lead service to be employed, when the laying, so far as the outside work is concerned, is complete.

Fig. 19.

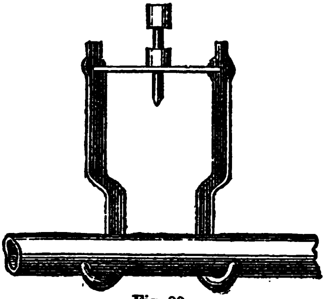


Fig. 20.

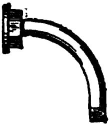


Fig. 21.

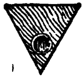


Fig. 22.

The house or meter end of the service must now be closed up, when the nipple, being well whiteleaded, must be screwed up, and then cased in coffin-wood. In some places—usually large towns—V-shaped coffin-wood—illustrated at Fig. 22—is employed, a mixture of tar, pitch, and sawdust being poured into the space between the wood and the pipe, in order to thoroughly cover the latter, thus forming a thoroughly efficient protection for both iron or lead pipes. The only drawback to this is, that it is exceedingly difficult to take up a service so laid, consequently, if it requires repairing it is a task involving some labour and time. Its great advantage is, however, that a service so protected seldom requires repairing, and when once laid, will last an almost indefinite time.

# CHAPTER II.

## *IRON SERVICE PIPING.*

**Best Time for Laying—Bridge Wood and Splines—Method of Working—Testing Meter—Remedying Defects—Making Connections—Gas Stoves—Gas Stove Burners.**

The preceding chapter has treated of the laying of a service with iron piping; in the present we intend treating of the running of a house with ordinary iron piping, which, it is almost needless to remark, is, like all other gas fitting, best done when the building is in a skeleton or carcase condition.

We must here remark that whether the house is in a skeleton or a finished condition, it is a *sine quâ non* that the iron piping must be let into the wall, and then covered over with plaster. In proceeding to fit up the house for gas, first mark on the walls and ceilings the various places for the brackets and pendants; and should the building be plastered and boarded, these must be cut away where it is intended the pipes shall run, the same method being followed for the laying of composition pipe, getting the run as straight as can be, so as to have as few bends and sets as possible. This done, plug the walls for the brackets with square plugs—these being an absolute necessity—and fit in the bridge wood for the chandeliers, using splines as previously recommended. Next fix the meter in the cellar of the house, and run the iron piping to within about a foot or a foot and a half of the meter outlet; next connect with composition or lead piping and fit on the caps and liner. Then screw a bend on to the end of the pipe which is the farthest from the meter, and now carry the pipe through the first-floor room to the second floor, working beneath the boards. This accomplished, screw a T-piece on—previously whiteleading the screw joints—so that it comes very nearly flush or level with the top of the joist—about a couple of inches below the level of the boards will generally be found ample. When this is done it allows of a fall from the branch and the main pipe, which will be found quite sufficient in houses where iron piping is employed. Now strike off from the left for the supply needed for the first floor and the back bedrooms; after which strike off from the right, carrying the piping over the joist and behind the skirting board, of course, with a bend, so as to supply the brackets in the second and third-floor rooms. If it can at all be in any way avoided do not use elbows, as they very much impede the regular and proper flow of the gas. This done, next run the piping up the wall for a distance of about 5½ feet, when screw on a diminishing T-piece. Now presuming that the main supply is to be ⅛-inch, the T-piece should then be ½ by 2/8 centre. From this T-piece take the supply which is required for the bracket, after-

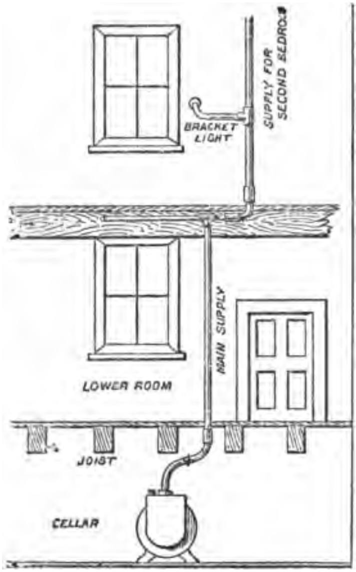


Fig. 23.

wards carrying the pipe up the wall and through the ceiling into the upper apartment, for whatever lights may be there needed, as depicted at Fig. 23, which gives a very clear view of the method of procedure to be followed. When the workman is running the piping to the bracket, the pipe, if so desired, can always be diminished in size. The pipe having been run up the walls for the brackets in the first and second-floor rooms, the fitter must strike for the pendants which may be required for the front lower rooms and the back rooms—say, a back dining-room, for instance, as shown at Fig. 24. In some instances, bedrooms are provided with two brackets, one being placed on each side of the mantel-board. When such is the case, a diminishing T-piece must be fitted in somewhere, and the piping then run from that to the first bracket, and thence to the second, as illustrated at Fig. 25.

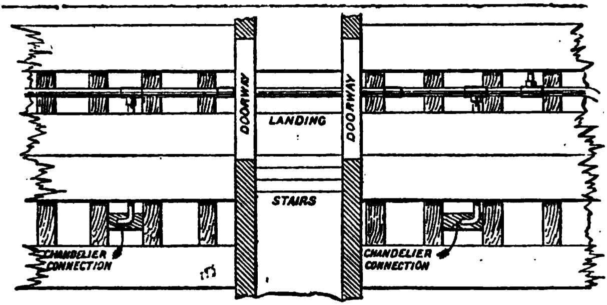


Fig. 24.

In cases where iron piping is run from a T-piece, bend or elbow along the joists, and not in or over them, as previously directed they should usually be, and likewise be particular to put the T-piece in close to the joist, in order that the pipe may be hooked close into this, and thus be afforded a stable support.

Presuming the pipe to have now been run to each joist, and the back knees screwed on to the desired length, the operator must next proceed to make up the various fittings and renew all damaged plaster, making it good everywhere where the wooden plugs and iron pipes have been let into the walls, by means of plaster of Paris. As this plaster at times sets very—in fact, almost too—quickly, it is always advisable to mix a small quantity of mortar with it, to make it work better.

Should it happen that the house is tenanted, the whole of the fittings can be tested by means of the meter test given elsewhere. Should the house be in a skeleton condition, then proceed to cap up all open pipes, and test the meter as directed farther on in this work, when, should there be any escape of gas, it can be easily remedied, and much better than when the building is finished and occupied. Should no escape be detected, the caps can be left on until the plastering, papering, &c., has been finished, when they can be removed to make way for the final fittings.

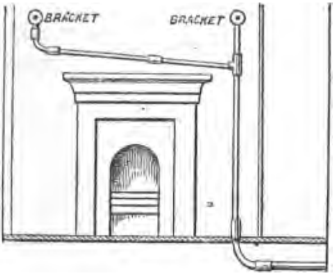


Fig. 25.

When making the connection for a chandelier to the iron pipe, instead of employing a brass head from the long screw which projects above the bridge wood beneath the flooring, it is better to use a straight coupling fitted with male and female screws (otherwise, convex and concave) for the union, and make the bend from the iron pipe as represented at Fig. 26. When cutting screws on iron piping with stocks and dies, the workman must always take great care to have the thread perfectly straight; pipes are very often threaded unequally or lopsided; especially is this the case when the dies are not cut well in themselves, by the dies being tightened up at the same point each time they

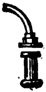


Fig. 26.

are run up and down. This should be avoided by the fitter.

All being joined up beneath the flooring the boards can be replaced, a piece being previously cut out over each of the chandelier connections and fastened down with screws, in order that, in case of an escape of gas, the fittings can be readily got at and the repairs effected, or for the disconnection in the event of the chandelier being taken down—as for instance, when giving up the house.

Before closing this chapter, and while on the subject of fitting up with iron pipe, we will supplement the information given in the preceding chapter with a slight digression upon gas stoves, taking for our present purpose a large-sized gas stove, suitable for cooking for a moderately sized establishment, which is, of course, to be devoted to cooking purposes only.

Supposing this stove to have been fixed in the position which it is to permanently occupy, run the iron supply pipe to within a foot and a half, or a couple of feet of the inlet union of the stove, after which screw a cock and union on, this being fitted in such a position that if it is desired at any future time to remove the stove, this cock will not project or be at all in the way. This done, connect up with either iron bends, &c., or copper tubing, as illustrated at Fig. 27. Do not use either lead or composition pipe for the connections of a gas stove. Should the operator decide to connect up with copper tubing, it is always better to make a template with a piece of leaden tubing, of the exact shape it is desired the copper piece should be, and then gradually to bend this latter to it. This will save both time and trouble besides preventing mistakes which would be almost sure to arise if the bend required were at all an awkward one.

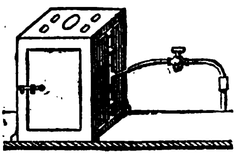


Fig. 27.

With care and attention anyone following out the above instructions will have but little difficulty in fitting up a gas stove—cooking or otherwise. And now a word as to burners. The best to use are those with steatite (a kind of earthenware) tips of the flat-flame shape, as these tips at a low pressure give better results than those with two holes, and when burning to waste make the fact apparent by roaring

# CHAPTER III.

## *TOOLS AND THEIR USES.*

**The Blowpipe—Tools and their Prices—Complete "Sets," and where to procure them.**

Perhaps one of the most handy tools in the gas-fitter's bag is the *blowpipe*, which is an absolute necessity, and which is illustrated at Fig. 28. A much better and more modern appliance can be now obtained in the shape of a small hand-lamp, with a blowpipe action which is operated from the top. This is to be recommended, as it does not entail any expenditure of wind on the part of the operator. For those, however, who cannot procure this apparatus, we illustrate the ordinary blowpipe. Joints made by the blowpipe are stronger, neater, and made in half the time than they can be by the copper bit, which is generally only employed by gas-fitters for the purpose of trimming brass and copper articles—and *never* for anything else in some portions of England, in the Midlands for instance—and but rarely by a man who knows his business in London. The method of using it is thus: First prepare the joint and have it perfectly clean, and then smear the joint round with a mixture of oil and resin, made by melting resin in a ladle over a fire, and then adding any common oil to it, next well mixing it, taking care that it is not too thick.

Fig. 28.

Then take the rushes, presuming the old-fashioned blow-pipe illustrated is used, or the more modern lamp above mentioned—some prefer a candle—in the left hand, put the thick and straight end in the mouth, and in the right take a strip of solder, this solder being in one-foot lengths. Then blow a clear and steady blast, keeping the point of the blow-pipe about one quarter of an inch from the flame of the candle, and so direct the flame on to the joint in process of making, which keep touching with the solder until the flame is sufficiently hot to melt the solder; then work round the joint without melting it, and blow it until the joint is made and neatly flushed all round. The solder should be made of equal proportions of lead and tin. To blow a neat and sound joint will require some practice and perseverance, but it is to be accomplished if only stuck to. As will be readily imagined, solder, resin, oil, and rushes will also be necessary. A pair of cutting pliers must also be provided, the cutting edges being particularly useful for the separating of the iron binding wire employed in the "twigging up" of bracket and other lanterns. The registered combination pliers, made by Messrs. Melhuish & Co. are the best, they combining in the one tool bell-hanger's cutting and gas burner pliers, with wire-cutters, turnscrew, and rimer, the price ranging from 2s. 4d. to 2s. 10d. per pair. One or two pairs of double-hole gas pliers should also be provided, these costing from 1s. to 3s. per pair. A hammer and a mallet, with some metal files, should also be included in the outfit, which should likewise have a brace with stocks and dies, a screwdriver, a chisel, gimlets, bradawls, nails, screws, &c. A complete set of screw tackle, including taps and plates, will form rather an expensive item in the kit, namely, about 18s.; but the manufacturer above-mentioned sells a set of gas-fitter's tools, including snips, for about 48s., which we would advise the amateur to purchase, though a few other tools will also be found necessary. These "sets" are put up in strong oak boxes, and will be found to answer all ordinary requirements. Buck's, in the Tottenham Court Road, is also one of the best houses in London at which to obtain tools, but as they are always to be relied on, they are a trifle more expensive. We have refrained from illustrating any of these tools, other than the blow-pipe, as their appearance is sufficiently well-known to most persons, while those in doubt can speedily become acquainted with them from the tool dealer's price-list; and their use is sufficiently apparent to all but the veriest amateur.

# CHAPTER IV.

## *METER FIXING.*

Meter Irons—"Scamping" the Work—Joining the Service—Necessary Cautions—Filling the Meter—Joining up with Lead Services—Blowing a Joint—Iron Piping and Unions—"Sweating"—Fixing Large Meters—Table for Lights, &c.

Having in the preceding chapters treated of service laying, the best descriptions of piping, and tools and their uses, we shall now pass on to the next branch of our subject, namely, the fixing of the meter.

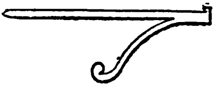


Fig. 29.

Presuming the service to have been properly laid, and the fixing of the meter decided upon, procure two meter irons, shown at Fig. 29, which are generally made in ⅜-inch square iron, and sufficiently strong for either 2 or 3-light meters. Supposing the meter to be a 5-light one, then ½-inch irons must be employed; while, for a 10-light meter, ¾-inch irons will have to be used; but irons are seldom or never utilised for meters carrying more than 10 lights. For these, supports made of wood, and about 3 inches square, are wedged into the wall, or the meter can be placed on a floor board, but this will of course depend upon individual circumstances—such as the position of the service, the space at disposal, &c. The irons being fixed, and the position of the meter determined on, the cap from the iron service must be unscrewed and the main tap screwed on. The irons for the meter must be very firmly driven into the wall, and if this will not hold them satisfactorily wooden plugs must be employed to tighten their grip. If it can be possibly so arranged, the meter should not be more than a foot from the service. All these preliminaries being satisfactorily arranged, the union of the main tap must now be soldered on to the composition pipe for connecting up; and here it will be as well to remind the gas-fitter—be he amateur or professional—that he should always employ the blow-pipe if he is at all able. The union of the main tap must next be screwed on, the meter placed in its proper and final position, and the length of inlet connection ascertained by carefully bending the composition pipe in easy and as large curves as possible to the inlet union of the meter. On no account must the fitter make sharp bends in the piping, as, besides its impeding the proper flow of gas, it is apt to cause a slight crack or fissure, and thus allow of the gas escaping, therefore gas-fitting should never be "scamped" or done in a hurry. The required length and form of the piping having been ascertained, cut it off, leaving just sufficient to make the joint in the inlet union, then take it off the main tap and also take off the inlet union, and solder to the inlet; then place it back, and, if the job has been properly done, the inlet connection is complete. A piece of composition pipe of the length necessary for connecting the outer meter must now be procured, the outlet union being taken off and the pipe soldered to it. This done, take the meter off the supports and proceed to solder the outlet to the interior piping, then place the meter back

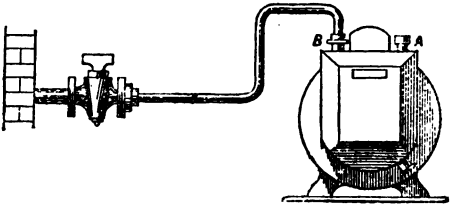


Fig. 30.

into its final position, put the customary leather washers on the unions and screw them tightly up, when the connection will be completed, as shown at Fig. 30.

And now for a few cautions, necessary, the more particularly to be observed by non-professional workmen, when making gas connections, though at times accidents happen to professional workmen through want of attention to these simple measures, laziness and indifference generally being at the bottom of them. If it can possibly be avoided joints should never be blown close to the meter, while, if it is necessary to employ a light—be it candle or rushes for the blow-pipe—near the meter when connecting up, always take the precaution of stopping the in and out pipes with a cork or cotton waste, or even a dab of white-lead, as, from negligence in this respect, very many meters have been at various times blown up and serious injury caused to the workmen through the proximity of a light when the inlet and the outlet have been open, the gas, of course, being ignited by the flame.

The meter now being fixed, and the whole of the connections properly effected, the next thing is to fill it. Supposing it to be a *wet* meter, take the outlet off, and then unscrew the plug A and the syphon cap B; then, by means of a funnel, pour water into the meter until it commences to escape by the syphon B, an ordinary pailful generally being quite sufficient to fill a 2 or 3-light meter, and if the workman possess a garden watering-can he can generally dispense with the funnel. So soon as the water ceases running from the syphon B the outlet must be again screwed on, and the main tap turned on, when the gas will expel any superfluous water that may be in the meter, this fact being made known by the bubbling noise from the syphon B, then screw the syphon cap on and the plug A, when the meter will be ready for use. Before using always take the precaution of testing the inlet and outlet unions for any escape of gas—and do *not* do so with a light. Occasionally, when a new meter is fitted, there is some slight difficulty in getting the gas to pass through, and this will, in the majority of cases, be found to be due to the float sticking. In such a case the meter must be taken off and a little hot water poured down B, when the float will be loosened and rise, when, if the operator will gently blow down the inlet B, at the same time placing his hand firmly over the outlet, he will be able to tell if there is the proper passage through the meter; if not, he will then have to thoroughly overhaul the meter and its fittings, refixing when the defect has been remedied.

Seeing that the method of fixing dry meters is precisely similar to that pursued for wet ones, we shall not weary our readers with a needless description, merely contenting ourselves with giving the form of the syphon, illustrated at Fig. 31, to be employed where the service falls to the meter. In wet meters these syphons are never used, and, in fixing a dry and outlet meter, it is just as well to bear in mind that it is always advisable to so syphon the inlet as to prevent any water making its way into the meter.

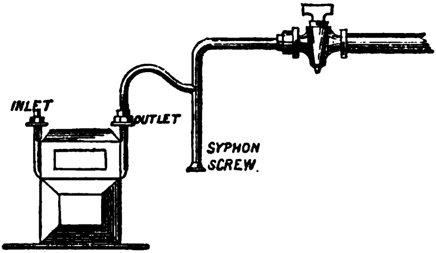


Fig. 31.

Having, in the foregoing, treated of the connecting of meters with iron services, we shall now treat of the fixing of meters with lead services, in which more care will be necessary owing to the inlet connection, shown at Fig. 32, having to be first made complete, the tap and union being soldered together before fixing, and then blown into the service pipe while the gas is on. To set about this is as follows: Place the meter in position, then fix the connection on to the inlet and bend it to the necessary form so as to meet the service. This, with the connection where the pipe is to be cut to form the joint, must then be marked with chalk, then the connection taken off and the cut made at the required place, the end of it being opened slightly with the tan-pin or other handy tool, and made a little larger than the hole in the service and then cleaned. Then cut the service where marked, the hole being "tanned" out sufficiently large as to admit the end of the connection, as illustrated at Fig. 32, and, as in the other case, also cleaned, to allow of the junction being properly effected. Here the workman must exercise care with his rushes or other light, holding them very low down so that the flames do not ignite the gas issuing from the service pipe. The form of the joint is shown at Fig. 33, and we give our readers a clearer idea than any description would. The connection must now be put into the service, and, with a gentle pressure, slightly ground in, as this very materially helps to make the joint gas-tight. Let the assistant now hold the pipe very steadily in its desired position, smearing all round and over the joint with the tallow from the rushes or an ordinary candle, or oil and resin, which effectually prevents any slight escape of the gas which might accrue from a defect in the joint, while at the same time forming a flux for the solder. Extreme caution must now be employed in the fitting and the blowing of the joint, as, owing to the heat being too much directed to one spot, the pipe is apt to melt; while, if the job is not done with a certain amount of celerity, the joint will be a very ugly and unworkmanlike one indeed. Should the pipe not be

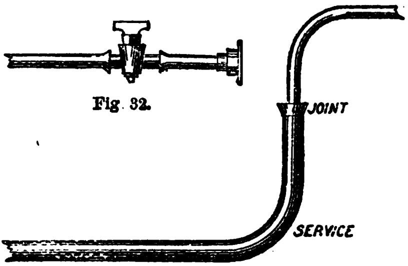


Fig. 32.

Fig. 33.

held steadily the joint is apt to come apart, the result of this possibly being some nasty burns, in addition to the work having all to be gone over again, when it is bound not to be so neatly done as if effected at the first essay. Should the workman be at all apprehensive that he would not make a good joint we advise him to use the copper bit instead of the blow-pipe, but we must certainly say that blown joints are the best, and the copper bit should never be used where it is at all possible to utilise the blow-pipe.

The joint made, the next thing is to connect the outlet in the manner before described, when the work will so far be completed.

Respecting lead services, we would here remind our readers that these are never used for meters carrying more than 45 lights, and it is also not usual to connect up with leaden pipe to meters carrying more than 80 lights, the connections from the services for meters of a larger size being always of iron. And in this connection we must caution our readers that, although a meter will always yield 25 per cent. more than it is marked—a 2-light meter yielding 3 lights, and so on—we do not, when speaking of the lights, mean those marked, but those actually given: thus by an 80-light meter we mean one marked at 60, and yielding in actual use 80. For meters which run up to as high as 80 lights, unions are usually used on the outlet and

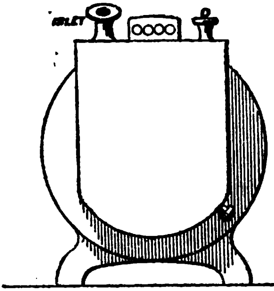


Fig. 34.

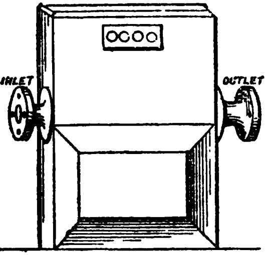


Fig. 35.

inlet for connecting, but for those exceeding that capacity, a flange is cast on the outlet and inlet, should it be a wet meter, as illustrated at Fig. 34, and if it is a dry meter this flange is let into it, as shown at Fig. 35, the flange being screwed for bolts usually in four holes.

When a meter is connected by means of iron piping and unions, the precaution must be observed to make the unions thoroughly fast to the iron connection; and by far the best way to effect this is to have a thread chased on this union, whether on the inside or outside is immaterial. If the former, it will, of course, screw on to the pipe; if the latter, it will screw into a socket. In either case the screw will not be a very good one, the thinness of the union not permitting of a deep thread being cut. The screw being made, then fix this union on to the pipe or into the socket, according to its being threaded on the inside or outside; then well tin round the joint thoroughly, afterwards putting, or, as it is technically termed, "sweating," plenty of soft solder into it, when, if carefully done, a good round serviceable joint will be the result. Should the connection from the service to the meter be at all long, the piping will require to be supported by means of ordinary gas-hooks or small brackets, so that the strain is taken off the meter and its service. If this is not done the piping is apt to drop, thus forming a possible lodgment for water, and crack, an escape of gas at once being the consequence.

When fixing at all a large meter care must be exercised when placing it in its final position, as any rough usage, such as suddenly dropping or jarring it, is very likely to break the spindle of the "drum," this generally being made of somewhat brittle metal. The meter being placed in its proper position, the cap must be taken off the service and the main tap screwed on, the threads, of course, being thoroughly whiteleaded beforehand; the lengths, bends, and flange must then be screwed temporarily together, and the connection tried to see if the proper length, &c., has been attained: if not quite correct, the meter can be slightly moved in order to accommodate it, but this moving must not be very much; while should it be necessary to make a set in the pipe, care must be exercised that it does not draw, shrink, or buckle, though if the instructions already given have been attended to, this is a very unlikely contingency.

Assuming the proper length and all other particulars for the connection to have been correctly ascertained, unscrew the various joints, and well smear them over with white-lead; then disconnect the flange, shown at Fig. 36, chalk the under sides of it, and lay it upon the inlet, then with a scriber or the tang of a file mark the positions for the drilling of the various bolt holes—usually four. When drilling these holes through the flange, take care to have plenty of clearance, and in order to have a good guide to prevent the hole running out while being drilled, with a pair of compasses strike a circle of the exact diameter of the hole it is desired to drill, centre-punching it about four times round for each hole, as shown at Fig. 37. The flange now having the holes drilled in it, procure a small piece of mill or any similar board, of about $\frac{3}{8}$-inch thickness, and on this mark off an exact fac-simile of the flange (this being to form the joint for the outlet and inlet), then cut holes through this board to allow of the bolts passing through, so that they meet the corresponding holes in the metal flange; then place in water for between four to five hours, when it will be found ready for use. While the soaking is going on, procure a spirit-level, and level the meter truly by packing up from both sides should it prove necessary—that is, laterally, and from back to front, or *vice versâ*. All should now be in readiness for the final and permanent connecting up; when taking the various parts to pieces, well whitelead each joint to prevent all possibility of escape, and then carefully screw together piece by piece, working onward from the

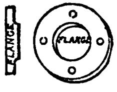


Fig. 36.

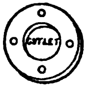


Fig. 37.

main tap, unless it is intended to employ a long screw in connecting up—under these circumstances the whole of the connection can be put together with the long screw at once.

All now being screwed together, take the flange and screw up very tightly, so that the bolt holes in it will face or meet truly the corresponding perforations in the meter flange; place the millboard or card washer, which is to form the joint alluded to above, between, first smearing it with diluted whitelead, but covering it thoroughly; then put in the different bolts and screw up very tightly, when the inlet connection will be an accomplished fact. The connecting of the outlet must now be proceeded with, the process being precisely the same as that for the inlet described above, with the single exception that it is always preferable to put a long screw in all cases where the meter is registered for more than 80 lights. Of course, this is a large size, and will seldom or never be met with by the ordinary amateur.

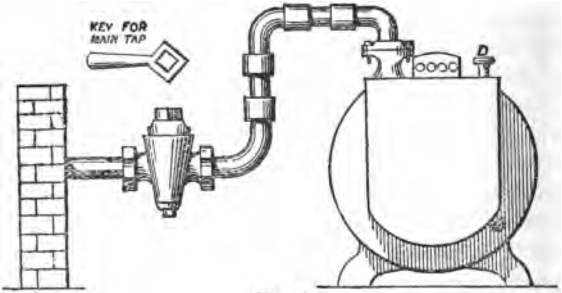


Fig. 38.

Assuming a large meter to be in question, and that it is a wet one, the best way to fill it, if it cannot be filled direct from the water branch, is to syphon it in, which is effected by putting a pail of water, in any convenient place *above* the level of the meter, then bending a piece of leaden or composition pipe so that it reaches from the pail of water to the plug D (Fig. 38), afterwards filling the pail, and sucking the water through the tube to start the flow, then placing it in the hole D, when the water will run so long as a continuous supply is kept up in the pail.

When fixing a large-size dry meter it is always advisable to syphon both the outlet and the inlet, except when the service has a decided fall to the main, when the latter syphon can be dispensed with, but the outlet must be invariably syphoned, as illustrated at Fig. 39, the same description answering for both when needed. A final caution as to lights, and we have done with meter fixing: always keep the inlet and outlet well plugged with waste when working by the aid of artificial lights—the electric, of course, excepted.

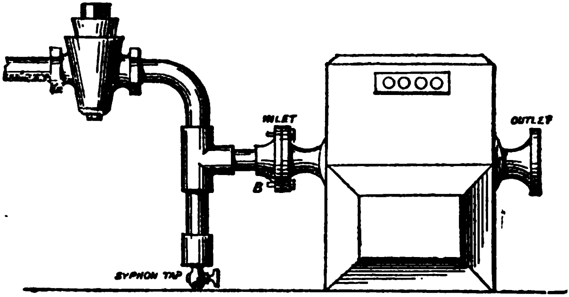


Fig. 39.

In conclusion, we append a table giving the sizes of the service, meter, &c., for a given number of lights, which will be useful alike to the ordinary householder and the professional gas-fitter.

| Service. | Meter. | Outlet. |
|---|---|---|
| ½ inch | 2-light | ⅜ inch |
| ¼ ,, | 3 ,, | ½ ,, |
| ½ ,, | 5 ,, | ½ ,, |
| ¾ ,, | 10 ,, | ¾ ,, |
| 1 ,, | 20 ,, | 1 ,, |
| 1½ ,, | 30 ,, | 1½ ,, |
| 1½ ,, | 45 ,, | 1½ ,, |
| 2 ,, | 80 ,, | 2 ,, |
| 2½ ,, | 100 ,, | 2½ ,, |
| 2½ ,, | 150 ,, | 2½ ,, |
| 3 ,, | 200 ,, | 3 ,, |
| 4 ,, | 400 ,, | 4 ,, |

# CHAPTER V.

## *FITTING UP OF SMALL DWELLING-HOUSES.*

**Plugging — Laying the Piping — Fixing Pendants — Advice as to same — Accidents — Testing for Gas Escapes — Dimensions of Pipes.**

THE meter having been satisfactorily fixed, and the service laid all right, the next thing to do in the supplying of a house with gas and its necessary apparatus, is to take a general look round, and having decided where the various lights are to be placed, to get the runs for the piping. In the present chapter we shall deal with the fitting up of a three or four-light house. Having settled the pipe-runs, we will imagine that the lights desired are two pendants, one for each of the two lower rooms, with a bracket for each of the two bedrooms. In setting out on the task, get a very long gimlet, and with it make a hole through the ceiling of the lower room and the boards of the upper one, this latter being a necessity, to show which board it will be necessary to take up to fit in the necessary pipes, &c. This ascertained, take up the requisite boards for the pipe-run, first hammering down the board nails into the joists, and then prising the board it is desired to lift up by means of chisels on each side above the levels of the companion boards, just sufficient to allow a clearance for the saw. Now saw the board into two parts, taking the precaution to sever it in the centre of a joist, in order that when nailed down again, the joist will act as a support to the two pieces of flooring, and refrain from springing or creaking when trodden on. The requisite boards having been taken up, next plug the various holes (in the instance under notice there will be two) in the walls where it is intended to place brackets. Where it is at all possible to make the walls good after damage, about three inches of the brickwork should be knocked out entirely, and a square wooden plug inserted, this being afterwards wedged in tightly. Where it is not possible—owing to the construction of the wall, or other circumstances—the flat plug, which is placed between the joints of the brickwork, will have to be employed; but we need hardly say that the square plug is by far the better, and if it is at all possible should always be used. This plugging of the bracket holes having been accomplished, next cut the requisite holes through the floor and ceiling, in order that the pipe may run to the meter, the best place being always the corner of the room farthest from the front door—this being especially the best plan to adopt if it is intended to run the pipe on the outside of the plaster. We may here mention, also, that a good way of disposing of a pipe in

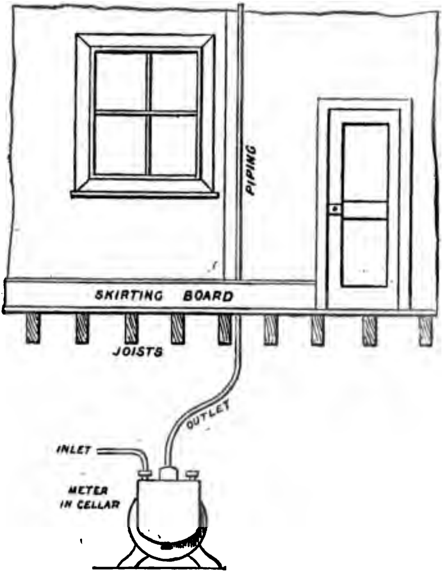


Fig. 40.

an ordinary sitting-room in as unsightly a manner as possible, is to run it down beside, and close up to, the framework of the door, when, being close to the woodwork, the pipe is hardly noticeable, especially if it be painted and grained to match the other woodwork. Should it be intended to let the piping in, it can be run alongside the window, as illustrated at Fig. 40. Premising that it is not let into the wall, and the necessary holes have been cut for the pipe-runs, get a chalk line, which stretch along the joists, this serving as a guide for the cutting of the grooves in which the pipe is to rest when the floor boards have been finally nailed down.

This having been done, next take the measurement of the distance between the meter and the hole in the ceiling, and then get the pipe, from which cut off a piece about a foot longer than the measurement given. Now stretch it, the workmen pulling one at each end, and a few vigorous tugs will soon straighten any pipe. If only one man is engaged on this job—which in the case of an amateur will most likely be the case—the pipe can be readily straightened by a few inches being turned over and nailed to a joist, and then vigorously pulled. Having straightened it, now pass the pipe through the hole already made in floor and ceiling, leaving a length of about a foot through under the

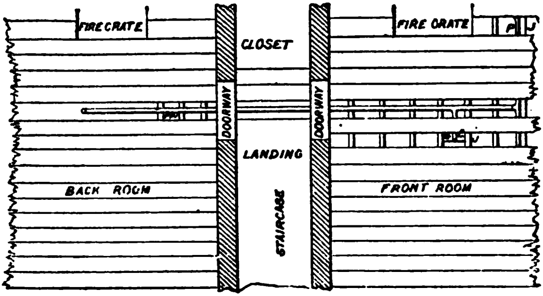


Fig. 41.

boards—this being the extra piece calculated for when the piping was cut off. Then run it straight (and in this be careful) along the wall, and affix it by ordinary gas hooks thereto. Now take a piece of pipe, which stretch sufficiently long that it will reach from the place where it is desired the pendant to hang to the first piece of pipe left beneath the floor boards, as shown at Fig. 41. Now pass it very carefully beneath the boards, taking care not to bend it or injure it in any way, to the first piece, when join it, afterwards supporting it beneath and close up to the flooring by means of strip wood, which can be made in two forms, both of which are illustrated in Figs. 42 and 43. In the former (Fig. 42) the wood is cut to pattern out of the solid piece; but in the latter (43) it is composed of two pieces, being placed beneath the flooring separately, and then nailed together, when under the boards, before being put into position to support the piping. The latter style is to be preferred, in that its power of resistance is very much greater, while it presses the pipe straighter and closer to the joists and boards than its compeer, which is very apt to give way when employed in long pieces, thus permitting the pipe beneath to lapse also, when a lodgment is afforded for water, jumping lights being the result. The whole of the strip wood being now under, take it up, and having examined it to see that it covers the pipe entirely, nail it to the joist at each end.

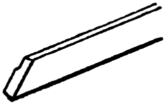


Fig. 42.

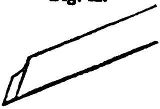


Fig. 43.

A piece of deal, 3 inches by 2 inches, must next be procured and cut to the exact length between joist and joist, this being necessary to form the bridging to which the pendant is to be affixed. When the pendant can be screwed to the joist—which sometimes happens to be the case—of course this bridging will not be needed. Under those circumstances a hole must be made with an auger in the joist for the connection, the fixing up being much simplified thereby. In the circumstances immediately under notice, that is where the connection is made between joists, having got the bridge wood the exact length, next bore a hole in it to meet the corresponding hole in the ceiling, and insert the piece of timber between the joists, fixing or bedding it as evenly as can be done to the lath and plaster, and finally nailing it at each end to each joist securely. A good job must be made of this, as otherwise there will be a prospect any night of the pendant coming down with a run without a moment's notice, to the certain damage of property and possible injury of persons.

Next procure a piece of ⅜-inch copper tube—brass will answer equally well if the former is not handy—one end of which must be screwed and the other end turned, and so bend it that the threaded end will pass through the hole in the bridge wood; then solder the other or turned end into the composition pipe, making a neat and workmanlike joint of it, and leaving sufficient of the screwed end through the ceiling to permit of the pattress block and pendant being screwed on.

And here a little advice—not to say caution—with respect to the hanging of pendants may not be out of place. On no account use the nose bits made of ⅜-inch brass tube, where they can be at all dispensed with, as it frequently happens that in screwing a pendant or other suspension on to one of these nose pieces, the latter parts company with the composition pipe, and in the case of a heavy and expensive chandelier this becomes a somewhat serious matter. An accident of this description cannot possibly happen if long copper pieces are employed.

The pendants finished, the piping must now be run for the brackets in the two bedrooms. For this, cut a hole behind the skirting board, to admit the pipe from the main one, then stretch a piece of the requisite length and work it through behind the skirting and under the floor boards, so that it makes a junction with the main pipe, resting on the joists. Now make the joint by blowing with pipe, &c., as previously directed; and when making a joint beneath flooring always be particular to see that the solder flows well and plentifully round the joint in every part, as otherwise an escape of gas will be the result, with a possible ultimate blow-up. This precaution must be more particularly taken with T-pieces, the soundness of which can be readily ascertained by holding a small mirror beneath.

The branch pipe for the bracket having been joined, make up with strip wood if found necessary, and then hook the pipe securely and straightly to the wall. Now solder the back piece on and affix the pattress block to the plug, and all will be in readiness for the affixing of the bracket.

Before finally closing up the boards and adjusting the bracket, &c., give a general look round to see that the pipe has been run straight, as nothing looks worse on a wall than a crooked pipe-run; while nothing acts worse, so far as the supply of gas is concerned, than straggling pipes under the boards. If it can be at all managed a slight fall should always be given from the meter to the main pipe, and the branches should also have a slight decline to the main. Proceed with the back rooms in a precisely similar manner to that of the front rooms of the house, running the piping straight across from the front to the back, when it will present the appearance shown at Fig. 41. This done, the requisite joints made, the boards, if any, nailed down, proceed to screw on the pattress blocks, pendants and brackets; next fill the meter as previously directed in Chapter IV., light up for a few minutes to see that all is right, and then make a last examination to see if the various joints, fittings, &c., are all sound.

For this testing there are a variety of ways, such as sucking the main pipe at the outlet, connecting a small air pump, or testing the meter. The two first given are by far the quicker methods, but a hand pump is not always available, and sucking is not pleasant or quite satisfactory always. The meter test generally answers all requirements, and it will respond whether the pipes be only 40 feet or 4,000 feet in length. As our readers are aware, a meter index is attached to all meters with lines and figures denoting the quantity of gas in single feet which passes through the meter, and in front of this disc is an indicating point or needle. To test the fittings, burn the gas until one of the lines comes dead opposite to the indicating point; then turn the gas off at all of the fittings, but leave it on at the meter. Should there be any escape, either in the fittings or the pipes, the disc will move past the indicating point. If the disc does not move in from a quarter of an hour to twenty minutes, the conclusion may be safely arrived at that the work is sound. If the disc moves, means must be taken to ascertain the escape, and a remedy applied, when all can be made secure.

In this chapter we have not given the size of the outlet pipe, as the table of dimensions in Chapter IV. will give the reader all the necessary information, but we may here remark that in populous towns, or where the greater part of gas-fitting and laying is done by contract, it has become a rather common practice to use ¼-inch lead pipe. This should never be done, as ¼-inch lead pipe will never carry more than a couple of lights, and only then will the illumination be at all satisfactory if there is a good pressure from the main; and with even these favourable circumstances, it should only be employed in cases where there is never likely to be any extensions. On all accounts taboo it. For a single or two-light, ⅜-inch piping is much to be preferred for various reasons: thus, it gives a better light when the pressure is low; it is stronger, and, consequently lasts longer; it costs a very little more, and it can be laid equally as quick and well as the undesirable ¼-inch pipe. We think we cannot do better in concluding this

Fig. 44.

chapter than by illustrating (Fig. 44) a very handy little tool which will be found useful for cutting away the plaster in houses in which the walls have already been plastered up—as would be the case in the one of which we have been treating, which was a fitted-up house—when it is desired to set the piping in the plaster. In such circumstances when hooking up the pipe take care to drive the gas hooks well in, so that when the walls are again made good, the hooks are well buried.

# CHAPTER VI.

## *FITTING UP OF LARGER HOUSES.*

**Fixing up of Chandeliers—Independent Lights—"Jumping"—Brackets—Gas Stoves—The Bunsen Principle.**

WE shall now proceed with the fitting up of houses which carry more than four lights, though we may here mention that the process is precisely the same, be the house large or small, the only difference being that the gas-fitter will require to exercise more judgment in the getting and laying of the various pipe-runs, while in large houses it is also necessary at times to fix syphons. In some of these instances it will be found advisable to fix syphons under the boards, but if at all possible, this should be studiously avoided. When it is not possible, however, to obtain a proper fall to either the meter or the chandelier, presuming the latter to be a water-slide, the best way then is to make a coil similar to that illustrated at Fig. 45, with a $\frac{3}{8}$-inch tap soldered into one end, the other being jointed into the lowest part of the piping; and should it be an absolute necessity to fix a syphon beneath the flooring, a board must always be left screwed, and not nailed, in order that the syphon can be got at from time to time.

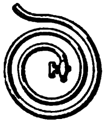


Fig. 45.

In old structures it not unfrequently happens that syphons have to be put in for every two or three lights, but in more modern buildings this seldom, if at all, happens if the work has been properly done in the first instance, and especially if the water-slide chandeliers are utilised as a fall, they can generally be easily got at, even if the meter itself is not handy.

Having treated of the general fitting up of houses large and small, perhaps some information anent the general hanging and fixing up of chandeliers will not be out of place here. In the majority of modern-built houses—especially in villas and the better description of residences, a centre piece is usually placed in the ceilings of the rooms where it is intended to fix chandeliers: the drawing and dining-rooms to wit. In such circumstances, if the pattress block has been screwed on before the putting up of the centre-piece, it often happens that the block cannot be utilised, when a chandelier of the following description must be used, the component parts in which are illustrated at Fig. 46. In this A is a chandelier rod with ⅜-inch iron long screw soldered in the ceiling plate, and leaving the long end of the screw to pass for about 2 inches through the bridge wood. B is a plate of brass with a square boss, cast on and topped ⅜-inch, to screw on to the long screw beneath the floor-boards of the upper room, and to draw the rod tight up to the centre-piece in the ceiling of the lower apartment. C is a brass bend screwed for inner and outer, or as they are more commonly termed, male and female, the last named screwing on to the piece of long screw projecting above the plate. D is a union

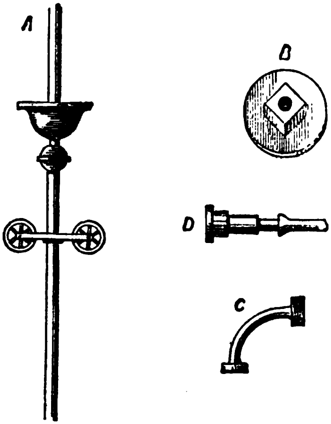


Fig. 46.

with a nose piece screwed in. This will finally have to be soldered into the composition pipe for the supply, when it will be complete as shown at Fig. 47. Whenever the chandelier carries more than a couple of lights this method of connection should always be employed, the precaution being taken of making certain that the bridge wood is securely fastened to the joists as shown at Fig. 47.

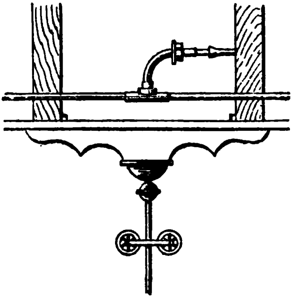


Fig. 47.

Perhaps the best way to fix this bridge wood, especially for heavy chandeliers, is to cut a piece out of each end of the piece of wood, and then to nail two splines, one on each of the two joists, in which the bridge wood will rest, nailing these splines securely to the joists, when the splines form about as good a support as it is possible to get. The form of the bridge wood by this method is depicted at Fig. 48.

Fig. 48.

When fitting up houses which carry a large number of lights, say twenty and upwards, it frequently happens that they have to be so fitted that the lights in any portion of the building can be turned off independently of the other, in fact, that any and each portion of the house can be supplied and kept burning separately from any other portion. There are two methods at least of effecting this: one being by the running of a supply from the main supply pipe, and then putting a stop-tap in some handy position, or by running two distinct supplies from the meter. This latter is effected by the fixing of a barrel in the outlet of the meter (see Fig. 49). This is generally made in lead pipe of the same dimensions as the outlet, and

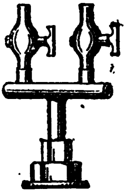


Fig 49.

is about 8 inches in length for a double supply. To do this job procure a piece of pipe of the required length for the barrel, cut the ends square and well clean them to take the solder, then cut two discs of lead to fit the ends, and afterwards well sweat them in with soft solder. Next solder on to the outlet, and finally solder on two stop-taps from which to run the two supplies.

When fitting up a twenty-light house, an inch service and outlet will be necessary, as, although highly improbable that the whole of the lights will, as a rule, be burning at one and the same time, still it may happen, as on a November day, for instance, that they will all be wanted at once, and it is therefore just as well to have the meter and service pipes sufficiently large; the table, however, in Chapter IV. will give all the desired information. However, to resume. The barrel being fixed, strike off with half an inch for each supply, and having supplied about half-a-dozen lights with ½ inch, it can be reduced to ⅜-inch for the remainder. All branches can be run with ⅜-inch for either brackets or pendants. Brackets should be fixed at a height of about 5½ feet from the floor, and pendants of all descriptions about 6½ feet, if with glass lustre ornaments a trifle more to guard against accidents.

We shall treat of a misfortune which has probably at some time or other affected those who have at all largely employed gas, especially when the pendant has consisted of the old-fashioned water-slide; this being the sudden stoppage of light, usually preceded by a more or less pronounced "jumping." In the majority of instances this is owing to the inner or telescopic tube being leaky and otherwise defective, which permits of the water finding a lodgment in the arms of the chandelier. When this is the case, a new inner tube must be fixed in, and this can be made of tin, this being quite as serviceable as brass, with the additional advantage that it will not split.

In many houses claiming to lead the public taste, it has become the fashion to dispense with the chandelier, beloved of our grandfathers, in favour of brackets. For an ordinary sized apartment three is a good number, one being fixed on each side and above the mantel-board, and the third one in the centre of the opposite wall. This is a good and pleasing method of lighting, and certainly has the advantage of preventing tall persons coming into contact with the bottom of the chandelier.

No house of any pretension is now considered complete without a gas stove, and as these handy appliances are becoming day by day more used for both heating and cooking purposes, it will not be out of place if we offer a few remarks thereupon. They vary much in form, but the majority follow the one principle, the most general being that in the plan of the one illustrated in Fig. 50.

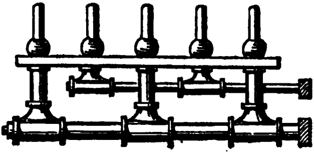


Fig. 50.

Before proceeding to treat of the illustration practically, we may remark that cooking by gas has much to recommend it—the principal being economy, efficiency, convenience, and cleanliness, there being no tedious preliminaries, such as the bringing in of coals and the taking out of ashes, as in the case of coal fire; while a gas and asbestos stove in a drawing or sitting-room looks every whit as pleasing as the much vaunted "cheerful" coal fire. Certain it is that for cooking purposes no coal fire can compete with a gas one, the food cooked by its means retaining more of its nutritious qualities and being more easily digested than that prepared by the older method, and to the poor it is to be commended on account of its cheapness. However, this is a digression which the reader will pardon.

In the illustration (Fig. 50) under notice, which follows the ordinary plan, the framework is so bent as to fit in under the ordinary fire-grate, being provided with atmospheric burners, two being upon one supply, and three upon the other, a total of five in all. The object of this double supply is in order that one may be kept at full pressure, while the heat can be reduced by decreasing the pressure on the other supply should it be desired. The question may, of course, occur, why not turn down the whole of the five burners, and thus reduce the heat all round? To those who propound this somewhat, at first sight, natural query, we reply that when these five burners are turned down very low, as would be necessary were it is only wished, for instance, to keep a dish warm and not cooking, a very slight down-draught will light the air-chamber, and at once spoil the fire until it is extinguished and re-lit. When the air-chamber gets alight, it is readily distinguishable by the hissing noise. To fix up a grate with five burners, as shown, the supply will require to be taken direct from the meter, ½-inch composition pipe being employed for the purpose. This must be carried under the flooring till within about a couple of feet of the stove, and a piece must then be cut out of the joist sufficiently large to permit of the supply-chamber being put into it. At Fig. 51 is shown the inlet, with two outlet cocks and unions. When fitting this chamber in, do not cut away too much of the joist, but only sufficient to allow of the tops of the outlet cocks coming flush with it. This ascertained, screw the chamber down securely in its place in the recess of the joist, then solder on the supply and connect

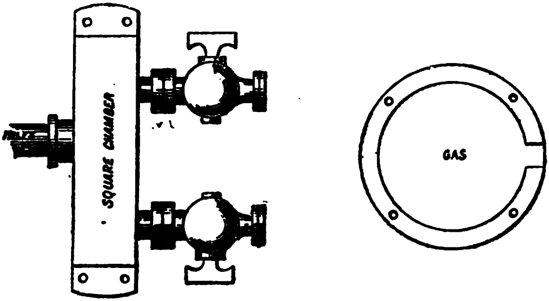


Fig. 51.

up; now run the two outlet pipes from cocks under the floor to within about 4 inches, and then connect with unions in the same manner as the supply. When putting the boards down in their places, cut a piece out, either round or square, of the board which covers the stop-cocks, and in this place fix a small ring-trap; this will permit of the taps being easily got at for turning the gas off or on, while they will be out of the way of children and meddlesome servants.

All being finished, if the fire is desired for heating purposes only, fill the grate up with pieces of asbestos, and in about a quarter of an hour as nice a fire will be obtained as need be wished, giving as much heat as one made of coal which had been burning an hour. When first ignited these fires sometimes smell, but this speedily evaporates. If for heating purposes only, the gas can be drawn from the ordinary house supply. Should the stove be intended for cooking purposes, we would advocate a hood being fixed 2 or 3 feet above it, with a pipe to the outside or let into the ordinary chimney flue. Thus not only the products of combustion, but the steam, &c., from the cooking, &c., pass speedily away. When such vents are fixed, there is far less steam, &c., in a room when cooking by gas, than comes from a coal fire oven, which of course opens into the room, without the protection of a hood. For cooking stoves the supply of gas should be taken direct from the meter outlet.

Gas consumed on the Bunsen principle produces the greatest amount of heat. Mixing with the atmospheric air, it burns with a blue flame, throwing off no soot, while the combustion is perfect. This principle is generally adopted in the manufacture of gas stoves for both heating and cooking purposes, but after they have been used for about a couple of years, they are liable to get out of order, when the air chamber will become ignited, the food being smoked in consequence. This is caused by the air chamber getting filled up with dirt and grease, and can easily be removed by cleaning the burners with turpentine.

# CHAPTER VII.

## *FITTING UP OF SMALL WORKSHOPS, ETC.*

Tanpinning for Blown Joints—Welding Iron into Composition Tubing—Relaying of Old Houses—Lighting for Work Benches—Necessity of Proper-sized Pipes—Remarks upon Burners, &c.

Before proceeding with the fitting up of workshops, we think it will be as well to supplement the preceding information with a few purely technical details, which may possibly, and very probably will, be of the utmost use to the amateur, though the professional, it is to be presumed, will not need them.

Thus in the blowing of composition pipe joints—the constituents for which are rushes, a blow-pipe, resin, and solder, and which we presume every one is capable of doing, certainly with a little practice—it is the general plan with gas-fitters to tan-pin one end of the pipe out, and then to file the end of the other piece down to make it fit in. This plan works very well in its way when the gas is off, but there are times, especially in our large manufacturing and trading centres, such as London, where it is absolutely impossible for the gas to be turned off while the joint is blown, and in those instances the tan-pinning and rasping of the pipe ends will not avail, as it very often happens that a large escape of gas cannot be prevented while blowing, often the pipe being melted, if no greater harm befalls. To prevent such casualties, a tool similar to that shown at Fig. 52 is employed, and if the workman provides himself with three of these, he will have all he needs for almost every description of pipe. The smallest one can be made for ¼, ⅜, and ½-inch piping, the second for ¾ and 1-inch piping, and the other for 1½-inch piping, which will answer all requirements.

These handy little tools have been so constructed that they clean the pipe the same time that they cut and open it for making the joint; but as a rule it is preferable not to have them with a cleaning edge, as they are somewhat liable to clean the piping too much, thereby weakening it considerably. Personally, we recommend the employment of these tools in all cases where compo-work is in question, as by their means the gas-fitter is enabled to make a cleaner and more serviceable joint than he otherwise would.

To make them, which can easily be done by any handy man, weld a small piece of iron into a piece of iron tubing sufficiently large that it will form the opening end, which done, turn it down to a cone shape, as shown in the illustration (Fig. 52). Then procure a piece of moderately thin sheet-iron—that of 18 gauge will be found to answer very well—and cut it out so that it will form the closed end, cone it round on any tool that is available, and then braze the edges together, after which braze the small end into a hole drilled in the full end of the pipe, when having freed it from the hard and superfluous solder, and polished it up brightly, it will be ready for use. We recommend piping instead of solid iron being used for the tan-pin end because it is very much lighter, and is equally as useful as the heavier ones.

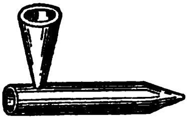


Fig. 52.

Following up our professional details, we shall now have somewhat to say respecting the fitting up with iron piping of houses after the flooring has been put down and completed—as, for instance, in the relaying of an old house. In such a case it occasionally happens that it is far from an easy task to get the iron pipe beneath the floor boards: thus, for example, we will imagine that the fitter has six feet to carry it from the main supply, and which cannot be got beneath the floor in one length except by taking up more of the boards than is agreeable, not reckoning the additional time which is also involved. To overcome these difficulties the pipe, being screwed at each end, must be put under in short lengths and screwed, when beneath the flooring, together. To effect laying of iron piping under such circumstances proceed as follows: At the commencement ascertain the exact length which will be required for the run; and if it should be about four or five feet, it can be divided into two pieces very well—say one of 2 feet in length, and the other of 2½ feet, or if the length is the latter given above, they can both be 2½ feet, and these pieces can, with very little trouble, be passed beneath the flooring without damaging it. Should the required run be larger, of course more pipe will be necessary, when the workman will have to use his own discretion, judging of the surrounding circumstances, as to the cutting up of his lengths. These ascertained and obtained, place them beneath the boards and screw together piece by piece, there being, as a rule, plenty of room between two boards with which to manipulate a couple of pairs of tongs for the screwing up of the various lengths of iron; and this is in fact the only way to lay lengthy runs of gas pipe without spoiling the floor boards—in the case of polished and parquet floors, for example, this plan must be adopted. Of course, circumstances alter cases, and sometimes longer lengths can be introduced beneath the flooring than those given above, this largely depending upon the widths of the boards taken up. When the various lengths are being got ready, the workman must be careful to observe that the threads on each are perfectly straight, so that when screwed up in their proper places there are no dips in the pipes, caused through unequally cut or lopsided threads. This slight matter is of greater importance than at the first blush it appears, as when the pipes dip they afford a lodgment for water, the result being jumping lights and a loss of temper by the occupier. To avoid this, the fitter should screw all his pieces up together before fitting them beneath the boards, and then placing them in order ready for use; his job will take very little more time, and be much better accomplished.

In accordance with the headline at the top of this chapter, we shall now pass on to give the necessary instructions for the fitting up of a small workshop with iron tubing, which we advocate always for places where work is carried on, except in the case of slight extensions, where the lights will be out of the way of knocks and hard wear, when composition pipe may be employed, but generally speaking, in workshops, composition is better when conspicuous by its absence. In private houses this style of pipe is all very well, as here the wear and tear are comparatively slight, while the occupier generally keeps a keen eye on the gas apparatus for his own sake; but it is a very different matter in large firms, where the employés require plenty of light and are not very particular as to how they obtain it, providing they do; then iron fittings are an absolute necessity. In addition to this, there are other potent reasons why the lighter and cheaper pipe should not be used, the principal being that, no matter how well put together and jointed, it is always liable to be crushed, with a consequent loss of gas to the master. Iron piping always repays for the extra cost and trouble in laying, in that it lasts twice as long and needs far fewer repairs than the composition piping.

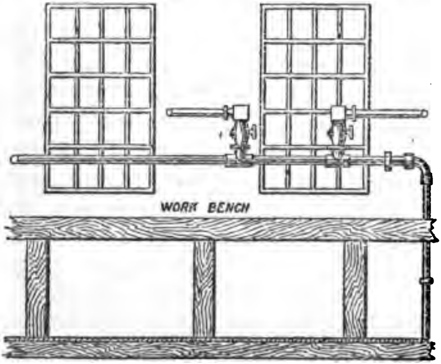


Fig. 53.

The workshop that we have in our mind's eye to be fitted up is one carrying twenty lights, which are to be so arranged around the shop that they afford light to lathes, vices, &c., as depicted at Fig. 53, the lathes and other apparatus being omitted from the illustration.

All preliminary arrangements being made, the piping must be run straight up from the meter, using 1-inch pipes for the purpose, unless extensions are contemplated at some future period, when it will be advisable to use 1½-inch pipe; which having been run up to the requisite height for the various lights, the places where the lights are to be fixed must now be marked, and between where the lights are to be placed plug the wall at distances of about four feet apart, this being necessary to enable clips to be screwed thereto. Next ascertain the lengths of the piping which will be necessary between each light, then screw them, and screw on also the T-pieces, 1-inch by ⅜-inch centre: Next carry the pipe round the shop, inserting the requisite T-pieces wherever a light is required, and into the T-pieces screw the necessary swivel cocks for the brackets, illustrated at Fig. 53. Another method for effecting this, and which saves much time, is to screw the swivel cocks into the iron piping iron, and thus dispense altogether with the T-pieces.

Should this plan be decided upon, the fitter must first screw the pipe together temporarily, then put it into the position it will finally occupy; next mark on it with chalk where the lights are to be fixed, and cut a hole in the pipe with a round-nosed cutting punch, shown at Fig. 54, afterwards tapping it out for ⅜-inch iron. This must be done carefully and neatly, so that the hole will take a good thread from the tap; but the amateur will discover that a cleanly cut hole is not made without practice. The hole having been tapped, care being taken not to have it too large, but just sufficient that the flange on the swivel-cock will bed tightly into the iron pipe, then file round it, and tin

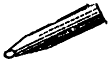


Fig. 54.

it with spirits of salts killed with zinc. The best way to make this spirit is to dissolve zinc in it until the spirits of salt will dissolve no more. It is then known as "killed" spirits, and should be poured off into a clean earthenware jar, when it is ready for use. The holes having been tinned all round, next tin the flange on the swivel-cock screw. Then screw both tightly together, and well sweat them in with soft solder, as represented at Fig. 55.

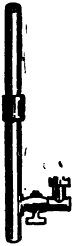


Fig. 55.

The method detailed and recommended is by far the quickest way of running a lot of fittings, though it cannot be commended for its thoroughness, it not being nearly such a good or satisfactory a job as when the T-pieces are employed, the great advantage being that a lot of time is saved. The swivel cocks having been all soldered in, next get the piping together in its proper position, and then screw the clips on to the plugged spaces in the wall. In places where the gas fittings are liable to be subjected to a considerable amount of wear and tear, the clips are to be preferred to the ordinary gas hooks, as, if the plugging in the walls has been properly effected, they will never give way. These clips, of which we give an illustration at Fig. 56, are made of ¼-inch by 1-inch iron, and to slip over the pipe, having a couple of screw holes in them on the flanges on both sides. The various pieces having been got together and securely fastened, next screw the arms on, which for the majority of workshops are required to be double, being about 2 feet 4 inches in length, and ⅜ inch by ¼ inch, with a universal swivel to form the middle joint. All being finished, test by means of the meter as previously directed, and then paint the whole of the fittings over with oxide paint, this being the best, as it will prevent the fittings rusting.

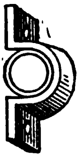


Fig. 56.

It very often happens that in the fitting up of workshops provision has to be made for the lighting of work benches, lathes, &c., which run down the centre of the apartment, in which case the illumination will require to be obtained from pendants from the ceiling. This is very often accomplished by having a separate pipe for each light from the main supply, and fixing on the ceiling with blocks and pendant tops; but a far better plan in every respect, both for strength and quickness of fixing, is to take the main supply and with it rise to the ceiling, then carrying it over the lathes, benches, vices, &c., as required, and putting in diminishing T-pieces at the intervals wherever necessary, and then putting in swivels, instead of in the T-pieces screwing in swivel cocks. In fastening up, clips, as before directed, should be used in preference to the ordinary hooks.

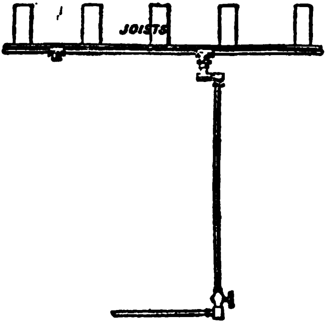


Fig. 57.

The pipe being now in its proper place along the ceiling, next ascertain and take the length of the piping which will be required for the rod of the pendant, screw this tightly into the swivels, and then affix F-swivel cocks to the bottom, as shown at Fig. 57, where the joists, ceiling, top piping, swivel, pendant, F-swivel cock, and branch are all shown complete. Where there are several tiers of workrooms to be fitted up, it is by far the better plan to run the supply about midway between, striking off for the lights on the right and left, as shown at Fig. 58; as by this means, when the supply is at one end only, those burners nearest the supply are often wasting gas, while those which are farthest, when the whole of the burners are lit, are often suffering from a deficient supply, and consequently bad light. When run midway the supply is equalised, and the lights consequently more uniform.

We would here caution all those who may contemplate having workshops or large buildings fitted up, to take especial care that the service meter and supply pipes are sufficiently large, as it is an expensive job when extensions or alterations are needed to have to go all over the gas fittings from basement to roof again, to say nothing of the impediment caused to business. It is a safe plan to pursue that, supposing 60 lights are required, to have all the appliances put down for the supply of 80, and although it costs a little at the outset it will speedily repay itself, should there be any extensions later on.

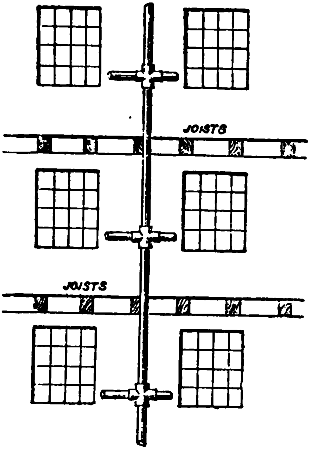


Fig. 53.

And here a few remarks upon burners for shops, workrooms, &c., may not be out of place, especially remembering the various improvements — all more or less beneficial—which have of late years taken place in burners, and in the governors, principally, attached to them. This is the best way to employ them, as by their means a less vitiated atmosphere is obtained, and a vast saving of gas effected; though in large establishments where a number of hands are employed, perhaps a governor fixed at the meter is the better—certainly it is the cheaper—plan, and under any circumstances we advise a governor being used; while the best burners, except for special kinds of work, such as wood engraving, jewellery and watch-making, stone setting, chasing, &c., are those known as fishtails, which give a broad, flat light. A good test to apply to a governor burner is to try one near an ordinary one, say where two or three dozen are burning. Turn these all off, and leave the governor and one common burner still alight, and it will be observed that while the governor remains burning steadily and clearly, burning no more gas than before, the common burner is making itself heard by a hideous roar, with a light which is next to useless. The extra cost is speedily repaid in the diminished gas bill.

In concluding this chapter we shall give some instructions which will be found useful should it be necessary to make an extension of the lights in a workshop or warehouse. Presuming that such an extension is desired, and that it is not convenient to cut the iron pipe and insert a T-piece, it can be done by cutting a hole in the piping with a cutting punch, as previously described. The hole made, tap it out, and then screw a male and female union into it. We do not, however, recommend this plan, as it is by far the better plan to cut the pipe and put in a T-piece; but if this is not practicable, the above plan will do, and has the additional merit of being quickly effected. It is shown at Fig. 59.

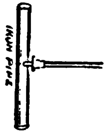
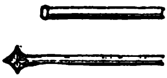


Fig. 59.

It often happens that when extensions of iron piping have to be made, there is a good deal of "brickwork" and "stonework" to be cut away, and we therefore append a description of a couple of tools employed for the purpose. Thus, Fig. 60 is for cutting away brickwork, and is commonly made of strong steam tube, having welded on the cutting end a collar of the very finest shear steel, which forms the cutting edge, while at the end which is struck by the hammer there is welded about 4 inches of solid iron, which forms a solid point for the blow of the hammer, and prevents the end from becoming burred up. In welding the steel on to the cutting edge, the smith when making it must open the end a trifle, in order to afford the necessary clearance. These drills are far superior to chisels for



Figs. 60 and 61.

cutting away brickwork; they cut cleaner, straighter, and quicker. In Fig. 61 is illustrated a drill for stonework. This must be made of 6 or 8 square "steel cast," and the end for the cutting point must be jumped up a little longer than the other portion in order to afford a clearance. These are far preferable to the flat drill, as they can be satisfactorily used by a novice, and will cut a round and clean hole all through. These two appliances should always be included in the gas-fitter's outfit.

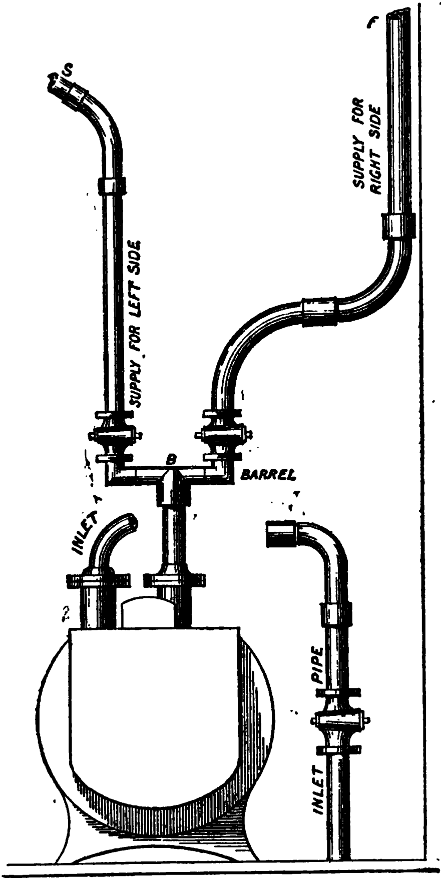
# CHAPTER VIII.

## *SERVICE FOR A LARGE WORKSHOP.*

**Fitting up for a Double Supply—Stone Buildings—Separate Supplies—Fixing Stop-caps.**

PASSING on from the fitting up of small workshops, we shall give the necessary instructions in the present chapter for the fitting up of a large workshop or similar erection with two supplies, the system now under notice only being adapted for buildings in which the whole of the workpeople commence and leave off work together. In places where there are half-a-dozen divisions, which start business and finish at varying times, the present method will not answer.

Supposing it to be necessary to fit up a goodly-sized establishment, say where from 150 to 200 burners are required, and where the workshops are of extreme length, it will be advisable to run a double supply from a barrel joined on to the meter outlet—that is, one supply for each side of the shop; while, should there be besides a row of centre benches, lathes, &c., it will be still more desirable to have a third supply from the barrel; but, for the present, we will treat of the first case—that of a double supply. If possible, get the meter fixed as a preliminary, and then make a barrel similar to that shown at Fig. 62. First, a T-piece is screwed on to the outlet pipe of the meter, and then two nipples are screwed about half way into it, one being at each end of the pipe, and on to the nipples at each end elbows must be fixed, which must be bedded to each other quite tightly. If it is not possible to screw them up sufficiently so that they both stand truly square they must not be unduly forced but unscrewed, and a small portion filed off of either the T-piece or the elbow — thus it will be found that at times the filing of a quarter of a thread will suffice, while, at other times, more will be needed, according to circumstances; and a little care and attention will soon enable the fitter to judge very readily. Presuming, however, that the pieces have been got perfectly square and also thoroughly tightened up, two stop-taps must be screwed into the elbows and then connected to the outlet of the meter, and then from these stop-taps the double supply must be run, striking off to the right and the



Figs. 62 and 63.

left for the respective sides of the shop, as indicated by the illustrations (Figs. 62 and 63), which convey a clear idea of the whole of the apparatus. In the case under treatment, the meter is supposed to be fixed in the right-hand corner of the end of the apartment. Should there be more than a single tier of workshops to be lit up, and the two supplies are, for instance, 2 inches, then rise up to the height desired for the supply for the first of the workshops and put on a diminishing T-piece on 2-inch ends by 1-inch centre; then go up again from the 2-inch end of the T-piece to the next tier, and so on for so many floors as it may be desired to illuminate, taking the necessary supply for each floor from the 1-inch centre of the T-piece. Should it be contemplated that at any future period any extension will be made, it will then be necessary to run the main supply all of the same size; if not, it may be diminished to 1½ inch after the two first shops have been fitted. In Fig. 62 and Fig. 63, B is the barrel; F the first supply for the right-hand side of workshop; S the second supply which rises and crosses over to the other, or left-hand, side of the shop. A reference to the illustrations fully explains the *modus operandi.*

The main supply having been run all right, and the T-pieces placed in their respective places at proper distances, the walls must be plugged at every 4 feet distance with square plugs, to which clips must be screwed with which to hold the pipe in its proper position, not omitting to give the shop supply a slight fall to the main, the plugs being adapted accordingly. Some lengths of 1-inch piping must now be procured and cut to the requisite length for the spaces between each light. This done, screw them and the T-pieces together. In this instance the T-pieces for the swivel cocks must be 1 inch by ⅜-inch centre iron thread.

In places where stone is largely employed for building purposes, the fitting in of a wooden plug is a matter of some difficulty unless a great deal of time is spent over it.

Even if the plug is fixed in a joint the advantage is very slight, as this joint is often so small as to render it practically useless. In such circumstances as these the wall will have to be plugged with lead. To effect this, first of all bore the screw holes in the block on to which the bracket is to be fixed, and from this mark where it is desired the screws shall go into the plug; next drill, with a stone drill, the two or three or more places so marked—generally, however, two will be the number—the size of the holes being ½ inch—or, if required, larger, according to circumstances—and about 3 inches in depth, and larger at the bottom than at the top, in order that the lead when it is put in may hold firmly. This done, take two wooden screws of the size for the block, which smear thoroughly all over with ordinary blacklead, after which well dust them over with powdered dry lead until they are quite dry. Now take a lump of plastic clay, and into it fix the head of the screw, afterwards putting the screw into the hole, working the clay round the outside of it, but leaving a small space open at the top of the hole to enable the molten lead to be poured into it. All this having been done, pour the hot lead into it until full and leave it to cool. When the lead has set take off the clay luting, and then clean off all the superfluous metal nice and flat to the stone, this being best accomplished by means of a sharp wood chisel, the cutting being done while the screws are in. Next take out the screws, when, if they have been blackleaded properly, they will readily leave the lead, in which a capital even thread will be found into which they can be readily screwed again. This is the best description of plug that can be employed where the ordinary wooden plug is unattainable, and is also to be recommended where there is likely to be much heat, such

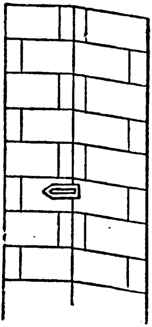


Fig. 64.

as from furnaces, &c. The method of plugging is shown at Fig. 64.

When large workshops or similar places are being fitted up for gas it is always advisable to get the various runs as straight as possible, so that there may be no unnecessary bends or sets, while it is always better to use bends in preference to elbows.

Some gas-fitters, when fitting up workplaces, adopt the mode of running the supply close up to the ceiling, and then putting in T-pieces where the lights are needed, then striking down from these with smaller piping and plugging the wall for bracket backs, as shown at Fig. 65. This method answers very well where the lights are few and far apart—and, in fact, in such circumstances the plan is to be preferred—but where the lights are needed at distances of every 3 or 4 feet the plan described in Chapter VII., Fig. 53, is to be preferred.

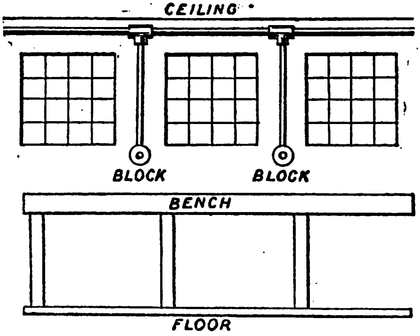


Fig. 65.

We will now treat of the fitting up of a large establishment where the various workshops are let out to various kinds of manufacturers, and where it is desired to employ one, two, or three shops, or, perhaps, only one or three, as the case may be, the remainder being turned off from the main supply, when it will be necessary to have a barrel made similar to that shown at Fig. 66. Under such circumstances, the supply from the outlet of the meter, which is generally about 3 inches, will have to be carried up from the meter into a room above, if there be one, or some other convenient place, where it can be easily got at, but at the same time out of the reach of mischievous boys and others, of whom there are generally plenty in a large factory. Thus, presuming the supply to be 3 inches, a T-piece, 2 inches by 3-inch centre, will be needed to form the body of the barrel, into which at each end must be screwed two 2-inch nipples, and into these latter two T-pieces, 2 inches by 1½ inch, must be screwed, and so on for as many more, fixed in the same way, as may be required; this depending, of course, upon the number of separate supplies required; finishing off with a couple of elbows, 2 inches by 1½ inch, one being at each end, as shown at Fig. 66. A piece of 1½-inch piping, about 4 or 5 inches in length, must now be screwed into each T-piece and elbow, and on to these screw male and female stop taps, and then on to the male thread of the tap connect with a long screw for each shop supply; next, on to each supply put a "bye-pass," so as to allow of sufficient gas to pass for about three or four lights in each shop, or other place attached thereto, so that when the main supply is cut off, a sufficiency of gas may be obtained to enable a few of the work-people to go on with their business. These bye-passes are fitted by employing two ⅜-inch brass bends and a union cock, as shown at Fig. 66.

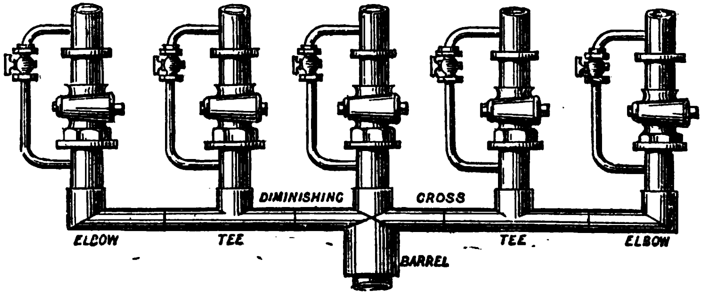


Fig. 66.

In some buildings, where the workshops are let off in flats, and the landlord supplies the gas for the whole of the house from one meter only, the method of fixing the supply is exemplified in Fig. 67, where a stop-cap is screwed into a T-piece in the main pipe for each floor. This same plan will answer admirably where there is a separate meter for each workshop, as the inlet supply for the meter can be taken from the T-pieces.

In our next chapter we shall deal with another method of fitting up workshops—namely, ground-floor,—which will be totally different from any of the foregoing.

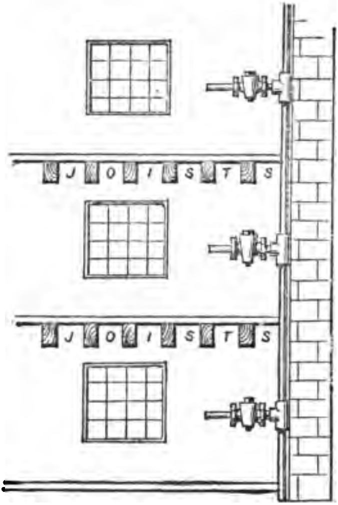


Fig. 67.

# CHAPTER IX.

## *GROUND-FLOOR WORKSHOPS.*

**Fitting up Engineers' and similar Shops—Counting-house and other Offices—The Benches—Forge Lights—General Principles.**

As mentioned in the preceding chapter, and in continuation of that portion of our subject dealing with the fitting up of establishments devoted to mercantile pursuits, we shall now treat with that branch devoted to the fitting up of shops in which heavy work is carried on, such as boiler makers, engineers, iron-workers, and similar branches of industry, and which it has of late years become more and more the custom to have on the ground floor only, and the fixing up of which with the necessary gas apparatus is totally different to any of which we have already given the instructions. In such a case as this the main supply, with its various branches, are run under ground, each light being taken from T-pieces put in at the requisite distances.

When such workshops as these are to be furnished, the gas-fitter must as a preliminary select a good position for the meter, which must always be a low point in the establishment, and at the same time as near to the main as it is possible, in order that it may not be necessary to extend the service. Care must also be taken to so fix it that the run for the main supply should be as straight as possible, and for this reason a good fall should be allowed to the meter. The main supply, and the various branches leading from it being, in such a case as that under review, below the ground, all the pipes will make a large amount of water, more particularly during the cold weather. At the outset, get the meter properly fixed if possible; but if not possible, then strike off from where it is intended the meter shall stand, leaving about 2 or 3 feet to connect with a long screw. Should the counting-house and clerks' offices not be supplied from a separate meter, it will, of course, be necessary to either make a barrel, or to take the supply on a diminishing **T**-piece on the meter outlet, similar to that shown in Fig. 68. Should a **T**-piece be put in, it must be connected, as shown in Fig. 68, with a stop-cap and a long screw, and should it be necessary a bye-pass, as previously directed, must also be put in. This done, proceed with the fitting up of the workshop. The main supply having been run to the first branch, put in a cross piece, or, should only one branch be required, a **T**-piece; next take the various measurements from **T**-piece to **T**-piece, or cross piece, according to the plan which may be adopted, and in taking these measurements care must be exercised so as always to allow for the depth or distance of the thread which will screw into each socket or **T**-piece, for if this is not attended to each of the measure-

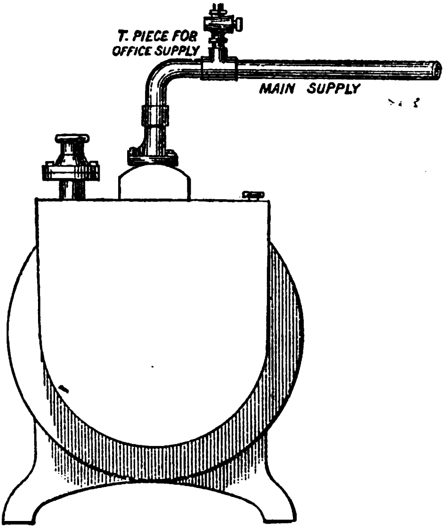


Fig. 68.

ments will be thrown out; thus, allow about ¾ inch of thread or screw for 1-inch and 1½-inch piping, and about 1 inch of thread for 2-inch piping, increasing it, if convenient, to 1¼ inch of screw for 3-inch piping, and 1½-inch thread for 4-inch piping, though an inch will answer, on a pinch, for both of the latter measurements; for ½-inch and ¾-inch piping ½ inch of thread must be allowed, and on no account must there be less, while all must be screwed on the taper, to insure close fitting. The main lengths having now been got out, they must be screwed together with the cross pieces, &c., and where the piping is run under the ground, as in the majority of cases of this description it will, the precaution must be taken to use plenty of white lead at the joints, which must be screwed up very tightly; for if a joint is at all loose under the ground the wet soon works through, eating away the threads of the screw, and causing a consequent escape of gas, which means an increased gas bill to the consumer, if not an accident at some time or other.

Now when the first T-piece or cross piece has been screwed tightly in, the fitter should reverse the tongs, and giving them to the assistant, let him hold the piece which has just been fixed in position, when the other piece can be screwed in, proceeding in such wise until the entire length of the main supply has been run, when it can be finished off with a T-piece or cross piece fitted with a plug, this being done in case an extension should at any time be needed.

This effected, the measurements for the branches required for each of the lathe, bench, or forge lights must be ascertained, and the lights put in as described. And here we may mention that it is preferable to have a long screw in from the main supply at each of the branches, so that, in the event of repairs, or of the pipes sinking and the water consequently lodging therein, the fittings can be readily disconnected and repaired. The T-pieces on the respective branches for the bench, lathe, and forge lights must point upwards for carrying the connection to them, which will be made plain on a reference to the plan shown at Fig. 69.

The main and branch supplies having been satisfactorily run, plugs must be inserted into all the open holes, and but little can now be done until the various tools, machinery, &c., are in their final positions, when the brackets can be fixed up. All being ready, the different lights must be put up, and this is generally a rather "fadding" bit of business, as in a large establishment, where lathes, screw-cutting, drilling, slotting, and such like apparatus are employed, the supplying of the light satisfactorily for the workpeople is such as to render the running of the piping so as to make a good workmanlike job a somewhat difficult matter, very few of the angles under such circumstances being quite square or "right;" consequently, where such is the case, the better way is to make the peculiar bends of composition piping, which can be readily bent to any shape or curve; or wire first, fitting the angles or corners of the respective machines, and taking care to get the fitting exact, after which the iron piping can be fashioned to the template thus made. It will sometimes

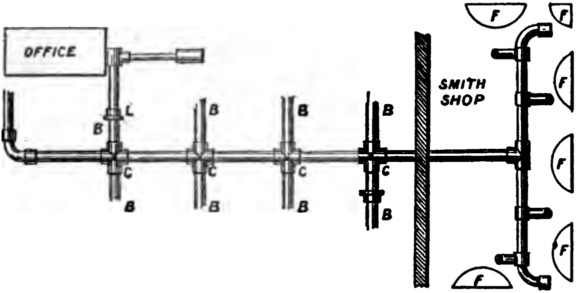


Fig. 69.

c, c, c, c.—Crosses in Main Supply.
b, b, b, b.—Branches for Lathes, Benches, &c.
f, f, f, f.—Forges, showing supplies thereto.
l.—Long Screw and Back Nut.

happen, where many sets are required for one piece of pipe, to connect them in some part of it with a long screw, but experience will readily prove to the gas-fitter when this is necessary. Whenever this is the case, it will be far better to make the various sets, &c., all on the one piece of piping correctly true to the template, afterwards cutting the piping, and then cutting a long screw on one end where it has been cut, as it makes far too many joints to put a separate piece in for a long screw. When the pipe has been fitted close to the machine required, as shown at Fig. 70, it will be necessary to affix the piping quite close up to the ironwork of the apparatus. This is effected by clips and screws; about two or three clips generally being quite sufficient for the purpose. The piping being now in position, place the clips (which should be made of ⅛-inch by ¾-inch iron) on the places where they are intended to be fastened, then mark the holes where the screws are to be placed by means of a scriber, a similar tool as previously directed, then centre-punch them for the drilling, afterwards drill and tap them, finally putting in the screws by which they are held in position.

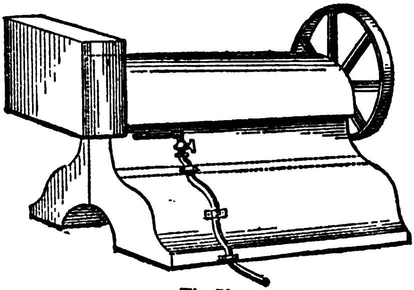


Fig. 70.

A word or two about drilling will not be out of place here. Thus, there is a variety of methods of drilling such holes as those above described, both in iron columns and machine frames, some workmen preferring a ratchet brace, while others affect a fiddle drill; but to our thinking a brace similar to that illustrated at Fig. 71 is much to be preferred, especially as larger holes than for a ¼-inch screw are but seldom required.

In use it will be found that a ratchet brace is exceedingly cumbersome and awkward, while a fiddle drill takes far too long a time in working, and these are our reasons for not advocating their adoption. Instead, however, the brace shown in Fig. 70 is handy, light, easy and sure in its working, and does its task speedily and thoroughly, while it will drill any hole up to ½ inch, and, what is better than all, it can be worked in a variety of positions such as are unattainable by either of the tools before mentioned. This in the fixing up of difficult lights is no mean advantage. The holes having been drilled for a depth of about ¾ inch, next tap them out, using a little soapsuds as a lubricant for cast-iron work; next screw a swivel cock on to the end of the supply pipe, and then fasten the pipe up with the clips, as shown at Fig. 70. It is preferable to employ either swivels or swivel cocks for such jobs as those here treated, as in the fitting of wing or bracket backs to iron framework far too much time is taken up, while the former plan answers equally well. When fixing up a forge light, always employ ¾-iron barrel, for the reason that, there being seldom anywhere to which to affix, it needs must stand out from the flooring as a pillar, for which a slighter barrel will not do. Of course, if a fastening can be anywhere obtained, ½-inch piping will answer all purposes. When fixing up forge lights, it is a somewhat general practice to screw the upright or pillar piece of barrel into a T-elbow, or bend, as the case may

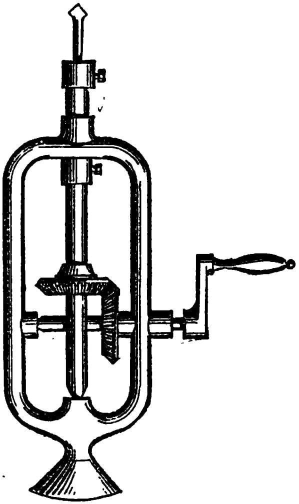


Fig. 71.

be, and then to bed or pack the earth round it for a support. This plan is not to be commended, a much better system being to procure a piece of wood, about 12 × 3 in., into which bore a hole sufficiently large to admit of the iron barrel passing freely through it. Then drop this over the T-piece, or elbow, screw the upright piece tightly in, next ram in the earth tightly on to the wood, which will prevent the pipe leaning, which would not be the case with the former and commoner plan. For explanation see Fig. 72. This plan takes a little more time, but it is much to be preferred, while a joist will generally supply the wood bedding. The above effected, next put on a swivel cock $\frac{3}{4}$ in. × $\frac{3}{8}$ in., iron size, and from the $\frac{3}{8}$ in. make the bracket. In this case, as in most others where the lights are to be used for mechanical purposes, make the bracket double, and, if necessary, even treble, employing for the middle joints universal swivels, the length differing according to circumstances. Do not have the brackets too long, and for this reason avoid treble brackets as much as possible, as all brackets beyond double are liable to get weak and drooping.

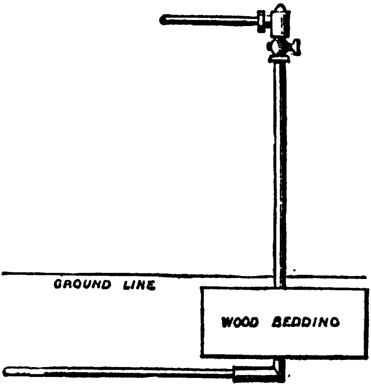


Fig. 72.

In such work as the preceding always employ the best material alike in piping and fittings, throwing away all which show the least flaw, as however much white-lead stopping in joints may do in private houses, these are totally unsuited to the rough wear of an engineers' workshop, where it is impossible for the work to be too strong or too well finished. Appearance in such work counts for little, the object being to have fittings which will wear well. All being finished, apply the meter test for half an hour, bearing in mind our previous injunction not to look beneath the flooring or elsewhere for an escape of gas with a naked light, as the result may be more disastrous than pleasant.

The above principles will govern the fitting up of any workshop, whether it carry half-a-dozen or a thousand lights, the differences being merely those of local detail, and if attention is paid to our instructions, bearing in mind that strong work is a *sine quâ non*, and also that iron piping must be employed, we doubt not that all will be satisfactory. Before concluding this work we purpose giving a detailed description, with sketches, of the various tools employed, this portion of our subject being manifestly intended for amateurs, though it is more than possible that professional fitters may find a "wrinkle" or two worthy of attention.

# CHAPTER X.

## *THEATRES, MUSIC-HALLS, ASSEMBLY-ROOMS, ETC.*

Inspection of the Building—Precautions to be taken—Star Lights—Refreshment Department—Wing and Stage Lights—Smoking Tables for Music Halls—Gallery Lights—Ring Burners—Ball-rooms, &c.

THE next stage in our work will take us to a rather heavy portion, namely the fitting up of a theatre—which will in great part answer also for music-halls and assembly-rooms, the only difference being that in the latter instances the lights are generally fewer and somewhat differently arranged.

In extensive works of this description, it is customary to work from the architect's plan, and this method is to be commended for a variety of reasons; but it sometimes happens, especially on a refitting-up job, that no plan is to be obtained, but that instead the fitter has to take down the old lights, and then put up the new ones according to his own fancy and discretion.

In such work as this, at the outset the fitter should make a thorough and complete inspection of the whole of the building, settling as he goes on the most convenient places for the various runs, and, if it be deemed necessary, the syphons, and keeping in mind thoroughly the fact that in a job of this description, deficient joining and consequent jumping lights must not be permitted under any circumstances. Be particular also to procure a good fall either direct to the meter, or the syphon, according to which plan is adopted. The meter having been fixed, next, from the outlet run the supply for the right-hand side of the stage, as shown in Fig. 73, and making a barrel, as represented in that illustration. It is almost superfluous to remark that it will very largely depend upon the class of music-hall or theatre that is to be fitted up as to how many outlets will be necessary to be fixed on the barrel; but in the majority of cases it will be found that outlets will be needed for the following, at any rate:—the foot-lights, the wing-lights, the dressing-rooms and green-room, the property rooms, and lights for stairs,

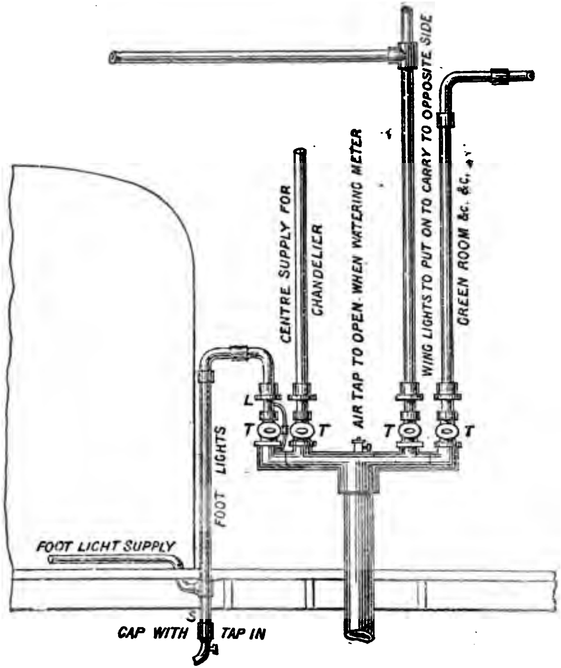


Fig. 73.

ante-rooms, landings, &c., &c., while one will also be necessary for the star sun-burner, or chandelier, in the ceiling of the auditorium, and one for the bracket chandeliers, should the house be illuminated by this means. In many instances, less than this number will be sufficient; for instance, in music-halls and places where full-dress dramatic performances are not given. No matter, however, what description of building it may be, it will be necessary, in every case, to insert a bye-pass into every outlet of the barrel, this being necessary to prevent the gas from going out entirely should the lights happen to be lowered too much, as will occasionally happen, if they are turned down hurriedly, during the progress of a performance. The main supply having been properly run, it will next be necessary to fix the barrel on, as illustrated at Fig. 73, after which proceed to run the various separate supplies.

In our illustration it will be observed that the footlight supply is represented as rising from the stop tap and again falling beneath the stage, it being syphoned as shown by the letter *s*. It then rises again on to the stage where the lights are required. Sometimes this supply is run on to the stage, and sometimes beneath it, but the latter plan is always to be preferred. The best lights for this purpose are undoubtedly the "Argand," as they impart a far brighter and steadier light than any other description, although they consume a far greater quantity of gas, and throw out far more heat, but in buildings of the description under notice these drawbacks are but of slight importance. Be careful, however, that wherever the supply is fixed, that it is thoroughly well stayed, in order that the chimney glasses will not burn and consequently fall off, while ballet or other dancing is in progress, and also take the precaution to protect them with a wire netting or similar guard, in order that the costumes or skirts of the performers will not catch light. The glare from the front of the lights must be taken off by means of shades similar to that shown at Fig. 74. The second pipe shown in Fig. 73 denotes the supply for the house; the third pipe that for the star or sun lights, chandeliers, &c.; the fourth that for the dressing-rooms and whatever gas is needed for the illumination of the green-rooms, retiring-room on side of stage, property-room, &c.; while the lights required beneath the stage can also be taken from this supply, because this will not, like most, if not all, of the others, need to be suddenly lowered during the progress of the entertainment. Whenever the theatre or hall is lit up with bracket chandeliers, these are usually run in a double tier on each side of the building, namely, in front of the rows of boxes, the piping being run beneath the flooring, and then struck up on the inside to each light, each pipe passing through a thick, strong, upright stay, usually of wood, on which the chandelier bracket is afterwards screwed. All these supplies must be run with iron piping throughout their entire distance and along the top of the bracket, being then fastened by means of clips and screws as described in a preceding chapter, and as illustrated in Fig. 75. Also each such light must depend from a strong cup-and-ball joint or socket, and this plan must also be pursued if pendants, chandeliers, or star lights are hung

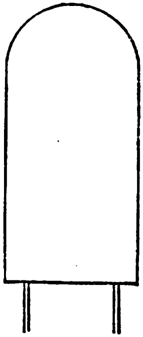


Fig. 74.

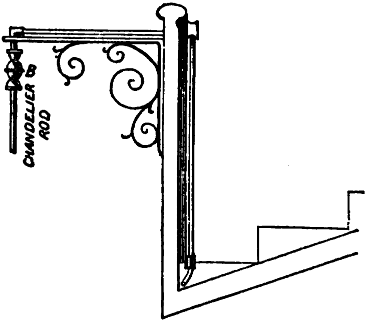


Fig. 75.

from the ceiling of the stage or auditorium, be the lights temporary or permanent.

When a building is illuminated by means of star lights, the supply pipe is generally run along the centre of the ceiling, over the various beams and joists, T-pieces being put in at the respective distances, while from these T-pieces are drop-pieces, so screwed in as to project for a distance of about 1½ inches through the ceiling, while this projecting piece must be a long screw. Between the various joists and beams the piping must be well stayed by means of strong bridge wood; pieces 4 inches by 6 inches will generally answer admirably. It must then be firmly held in position by means of a couple of flanges bedded against each side of the bridgewood, this preventing the drop-pieces from being screwed out, a casualty which has frequently been brought about by the turning round of the chandelier. For a clearer definition see Fig. 76.

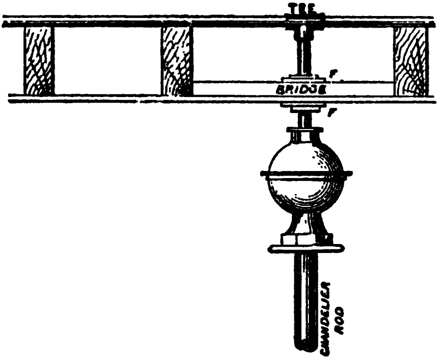


Fig. 76.

Should any lights be required for the refreshment department, which is generally situated in the front of the building, and over the principal entrances or for the exterior of the theatre or hall, the supply for the same can be taken from the main outlet before it reaches the barrel, care being taken to insert a stop-tap at some convenient place for the turning of the gas on and off. These outside lamps will require to be twigged in a similar manner to that detailed in Chapter XIII. for the fitting up of bracket and pillar lamps.

Of course, in all this the fitter will require to be guided entirely by local circumstances as to the manner in which he will lay the various runs after leaving the barrel, as it is seldom, if ever, that any two theatres or similar buildings are laid for their gas fittings precisely alike.

The supply pipe being run, the various fittings must next be put in, and the final to fix a board over the barrel similar to that illustrated at Fig. 77. This must be made of good strong timber—beech or oak—and have holes cut in it to fit over each of the stop taps. The *raison d'être* of this board may not at first sight appear, but it answers two very important purposes—it prevents mischievous boys and others tampering with the bye-passes, and it also serves as a guide to the gas attendant for turning the various supplies on and off round the holes so cut out. Round these brass rings are fitted and indiced with "Full on," "Half on," and "Off." Separate keys must be fitted to each tap, and these securely fastened on. Generally it will be found better to employ wing taps for this purpose, as they are far handier than the ordinary ones, but they must be kept thoroughly greased, so that they can be readily turned by the fingers. In Fig. 78 is shown a wing tap, and at Fig. 79 a species of light employed for temporary occasions, such as rehearsals, extra side-lights, &c.

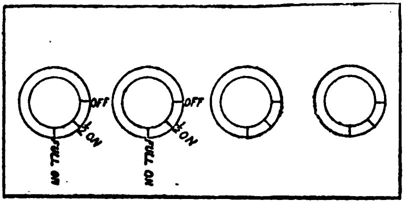


Fig. 77.

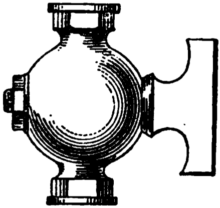


Fig. 78.

For the side wing lights for the stage, it will be found best to either punch or drill them, at intervals of 6 inches, using ¾-inch iron piping for the purpose, afterwards connecting them so that they run across the stage from one side to the other, and at the top it must be at the least a foot above the hanging drapery. The precaution must be taken to stay these lights at convenient points in order to prevent them swinging too near the light drapery, and thus setting it alight, this staying being particularly necessary at the top, owing to the greater tendency the lights there have to sway, and to the dangerous proximity of the "sky borders." As most of our readers are aware, when chandeliers and bracket lights are used for the interior of a theatre, they are usually of glass, with lustre hangings, and though exceedingly handsome, there is one great drawback with them, that they require a lot of cleaning and care, and for this reason star or sun burners are much to be preferred.

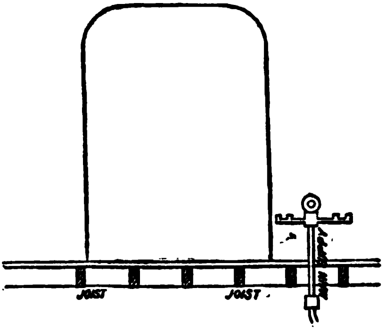


Fig. 79.

Although the quantity of lights needed to effectually illuminate a public place of amusement, such as that of which we have treated, will depend upon the length and breadth of the architect's plan, still the following will be found a sufficiently good rule for most requirements by which to work: procure the length and breadth of the building, then multiply both together for the number of square feet, next divide the product by 20, when the number of burners required will be given. The positions of these will depend upon the fitter's taste and judgment, combined with the architect's instructions. The best burners to use will generally be Bray's No. 2 or No. 3.

In the case of a music-hall the same system will apply as a rule, it being general for such establishments to have a barrel with three outlets—though in many instances two will be found sufficient, while the number here recommended, three, will always be found ample, viz., one for the foot and wing lights, one for the sun light for the centre of the auditorium and the bracket lights, and the third for the dressing-rooms, the exterior lanterns, and the refreshment saloon, a bye-pass being of course put on each. In the case of two outlets from the barrel only being needed, they can be distributed thus:—one for the wing and foot lights, and one for the sun burner, dressing-rooms, and refreshment bars, convenient taps being fixed so that each branch can be turned off separately, as each department will necessarily be supplied from a separate branch in the first supply; but for preference we recommend the triple outlet as being by far the more satisfactory in every respect. In the long run it is preferable to put on a distinct supply just below the barrel for the dressing-rooms and passages, as these lights may be required at times when the others are not. This extra supply is run about 6 inches below the barrel, and consequently in no wise affects the third supply. The arrangement is illustrated at Fig. 80.

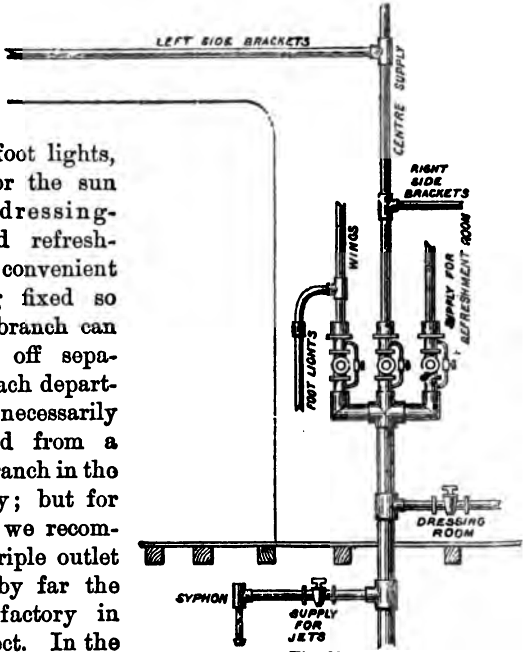


Fig. 80.

The centre is best illuminated by three star lights, the number of burners upon each of the stars depending upon the size of the hall, with other local circumstances; and if one or more galleries run round three sides of the building, the spaces beneath them must be illuminated by means of strong bracket lights, these being fixed at intervals of about ten feet apart, and at a height from the floor of eight feet.

In some of the larger and better arranged music-halls, especially in the metropolis and larger towns, it is customary to have in each of the small tables a jet, the light being for the convenience of smokers, and as it prevents the possibility of fire arising from the dropping of matches, the use of these gas jets is decidedly to be commended in all cases. Where these table lights are adopted, the supply for them must be taken from the main outlet before it reaches the barrel, when a stop tap must be put in, and then from this stop tap run about a foot of piping—or more if necessary—½-inch piping being generally sufficiently large for this supply—after which put on a T-piece, and then from one end rise, with a bend for the supply, beneath the floor, and on the other end of the T-piece fix a syphon. The best plan for running this is illustrated at Fig. 81. In the illustration the run is depicted as going across the floor, the T-pieces being put in to run straight down the body of the hall, and so that they fall beneath each row of tables. Of course, there would be more than the number represented here—four—but our illustration will convey the idea sufficiently well. In fitting up for these jets, a T-piece must be put in beneath each table, and then the supply must rise from that to the jet itself. The precaution must be observed of allowing a sufficient fall with each of the pipes to the cross

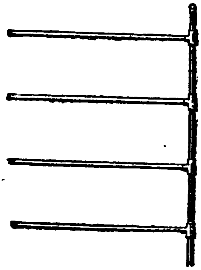


Fig. 81.

piece with the T-pieces, and then give that a good fall to the syphon.

In cases where the run is at all a lengthy one, and a good fall cannot be easily obtained, it is advisable to work with a spirit-level, which must be used on each length as it is screwed together, the pipe being packed under where it is necessary, and if these instructions are followed carefully, any mistake will be almost impossible. Half-inch piping should be used for this throughout the straight runs, but the T-pieces put in for the tables can be ½ by ⅜ centre, as ⅜ is every whit as strong for the upright pipes, these conveying all the gas that is necessary for so small a jet. The fittings for the tables must be thoroughly strong, and all thoroughly fixed, and the jet need not be above 4-inches in height, while all must be fitted with stop-cocks.

When running the pipe for the brackets—presuming, of course, that the hall is furnished with galleries—the best way to do so will be to strike off from the right and the left from T-pieces, as shown at Fig. 80, and then run as straight as possible beneath the galleries, dropping down at T-pieces put in at the various required distances, which would be about every 10 feet. The left-hand side is represented in the illustration as rising over the back of the proscenium, and then dropping down to a syphon, and it is imperative that this supply should have a drop to the syphon shown in the figure. This method will be found a far better one than running the pipe entirely round the building, as by this means the lights are more equalised, the supply of gas being consequently divided equally.

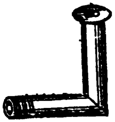


Fig. 82.

For the brackets beneath the galleries, an elbow drop screw, similar to that shown at Fig. 82, must be employed in fixing. These drop elbows are manufactured in almost all sizes on the inside or female screw end. The outer or male end is usually screwed ⅜ brass thread for the bracket backs to be screwed on to; the other, or female end, ¼, ⅜,

½, and ¾-inch iron thread, as the case may be. The various runs for these brackets having been satisfactorily arranged, the piping must be raised and run for the star or sun lights along the centre of the joists or beams in the ceiling, working in a precisely similar manner to that detailed in the former portion of this chapter, treating of the fitting up of theatres.

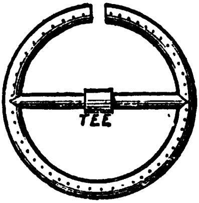


Fig. 83.

We shall now leave the stage and hall, and turn our attention to the fitting up of that very necessary and almost indispensable adjunct of a music-hall, viz., the refreshment saloon. In this bar one or two mullers for the keeping of hot water for grog will be an absolute necessity, and the best method for heating these mullers is by means of a ring burner, as shown at Fig. 83. These ring burners are usually constructed from ½-inch to ¾-inch piping, being afterwards bent to the desired shape—usually circular or oval—to accommodate the muller, the two ends, of course, having been previously welded up, and not left open as shown in the illustration. The cross piece is next made with an equal T-piece, and two small pieces, which are screwed into it. The ends will then require to be filed to the shape shown at Fig. 84, and afterwards fitted into the two holes already provided for its reception in the ring. First, neatly fit them together, and then braze the joint, either employing the forge or the blow-pipe—if the latter a gas one—tying the pieces for greater security with thin iron binding wire. When brazing these together mix the spelter with powdered borax and water, and to put it on, use a brass rod, flattened at one end. This will enable the workman to put the spelter on while the metal is being heated, and is especially handy when a forge is used. The ring burner being constructed, next proceed to

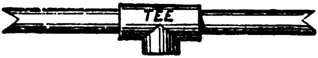


Fig. 84.

fit it. This must be made to burn on the "atmospheric" principle, that is to consume a mixture of air and gas; and to effect this, an air chamber must be constructed in which the air and gas can be mixed before passing to the consuming chamber or burner. In the top of the ring a series of holes must be drilled—using a 1/16th-inch drill for the purpose—at distances of about ¾ inch, which fill the place of jets.

The next job will be the air chamber or bulb, which must be constructed of the shape shown at Fig. 85, and hollow, having holes drilled in it of about a quarter of an inch in diameter, as represented. The bulb end must be tapped out for ⅜-inch brass thread, and the flange end ½-inch or ¾-inch iron thread, as the case may be. A ⅜-inch brass elbow drop screw must then be procured, and in one end of it a small piece of brass must be brazed, after which drill a hole in the centre not the least bit larger than an ordinary sized darning needle in diameter. This accomplished, all is ready for the fixing of the burner. See Fig. 86.

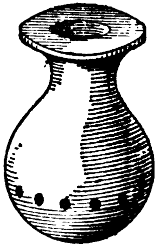


Fig 85.

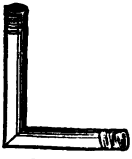


Fig. 86.

Attention must now be turned to the counter upon which the muller is to stand, and this settled, a hole will have to be bored by means of a centre bit or cut through the counter for this purpose. Take a piece of iron piping of sufficient length and screw into the T-piece of the ring burner, this latter being about ¾ inch below the bottom of the muller, or an inch at the most. One end of the pipe should be a long screw, namely, that which passes through the counter, and on to this a back nut must be screwed. Next fasten an iron plate, or "washer," about 6 inches in diameter and about 26 wire gauge, on so as to bed against the back nut; next pass the pipe through the hole in the counter, and then underneath fasten another plate. The air chamber must next be screwed on, and after that the elbow drop screwed into the bulb as shown in our illustration. It will then be ready for connecting up to the pipe and cock, which latter must be a union, and will then present the appearance of Fig. 87. After everything has been finally connected tighten up thoroughly the back nut on the top of the counter. Finally, procure a barrel board, as directed previously.

These ring burners are about the best of any for the heating of mullers in refreshment bars, as, if properly fitted, they throw off no smoke, dirt, or smell, while a good clear heat at a small cost is obtained, and although any other atmospheric burners will answer these purposes, still we can recommend the ring as being by far the best.

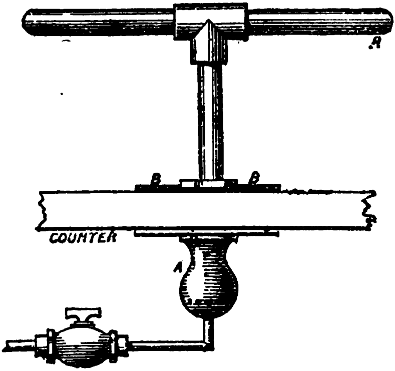


Fig. 87.
R. Ring Burner. B. Back Nut. A. Air Bulb.

As the last section of our present chapter, we shall now pass on to the fitting up of assembly and ball-rooms, which though somewhat—and in details very materially—different from theatres and music-halls, are yet to a certain extent connected, and for that reason we have thought it advisable to include this branch of our subject in the present chapter. In the fitting up of such establishments as ball-rooms, town-halls, assembly-rooms, and banqueting saloons, and such-like large places, one of three methods is generally adopted for illumination, namely, sun lights, star lights, or coronas, the last named but very seldom, as they are usually devoted to buildings of a sacred character, and in our next chapter, which will deal with the fitting up of churches and such like sacred edifices, we shall treat of the fitting of coronas fully. We shall therefore now only touch upon the two remaining systems, and as we have already given the details for fixing up these lights in the case of theatres and music-halls, it will not be necessary to here go into detail, seeing that they are generally adopted in assembly and other halls, for which the method of fitting would be substantially the same as that given in the earlier portion of this chapter.

For an assembly-room or town-hall it will be necessary to put a barrel on to the meter with three or more outlets, according to the size, and especially if there are shops built out in front of the hall, as is now frequently the case, particularly with our large modern hotels. When there are shops then three outlets will be necessary, one for the centre of the hall or assembly-room, one for the ante-rooms, passages, &c., and one for the outstanding shops. This third supply will have to be a somewhat large one, say one inch, and will require to be carried up from the basement of the house to the topmost story, with T-pieces inserted in every apartment, so that a separate meter may be supplied to each room or shop, and thus each tenant pay for the amount of gas which he consumes: unless, as is sometimes the case, the proprietor or landlord lets the shops, offices, or apartments at a rental in which the gas is included, in which case, of course, the supply can be run direct from the outlet pipe and the various meters dispensed with.

A few words respecting the hiring or letting of assembly and other public rooms may not be out of place here. Thus it is usual to make a charge of so much per night, inclusive of gas, but it occasionally happens that the room is let exclusive of gas, this being a separate charge. In this case, a register of the meter must be made before lighting up, and the same when all the lights have been extinguished, when the number of feet of gas consumed can be readily ascertained, and the consequent cost arrived at.

In the above all the necessary instructions have been given for the fitting up with gas apparatus of theatres, music halls, and assembly-rooms, and with the remark that the method for each is somewhat similar, we shall pass on to describe the fitting up of buildings devoted to religious purposes.

# CHAPTER XI.

## *CHURCHES, CHAPELS, AND PUBLIC BUILDINGS.*

**Fitting up Pillars—The "Composite" Plan—Vestry Lights—Barrel and Outlet Taps—String Course Piping—General Remarks.**

In this chapter we shall treat of the fitting up of sacred edifices, treating first of the furnishing of chapels, for the reason that in some cases the method more nearly approaches that pursued for music-halls and similar establishments than does that adopted in churches proper. For this transposition and digression we trust our readers will pardon us, when we at once resume our subject.

In fitting up chapels it is general to employ for the principal lights star or sun lights, coronas, and pillars. Wherever star lights or sun lights are adopted, they are fixed up according to the instructions given in the preceding chapter. Where pillars are employed, they are usually fixed along the tops of the pews, and in instances where these have been abolished, as is now the modern fashion, they are placed at the ends of the rows of seats, or bracket lamps are employed instead. At Figs. 88 and 89 we give a couple of the pillars generally selected for the illumination of chapels. They must be placed at intervals of ten or twelve feet, the necessary supply of piping being run beneath the floor, the branch for each light being up on the inside corner of each pew. In the case of open benches a different plan, to a slight extent, will have to be adopted, though the expense will be found to be in excess, than where the pew and pillar combination exists. When putting up these pillars, supposing composition piping is used—which we do not advocate—it must be boxed over to prevent it from being damaged. Of course, where iron piping is employed, this will not be necessary, but in this case the pipe will have to be secured by means of neat brass clips and screws, the former having three holes on each end, both being fashioned according to the illustrations, Figs. 90 and 91, by which means the plain pipe has an ornamental, and at the same time an ecclesiastical appearance imparted to it, and in every respect this plan is to be commended. Generally speaking, in arranging the lighting apparatus for a chapel, it will be found that a couple of lights will be necessary for the pulpit, one being placed on each side; in the case of a platform for a Baptist chapel four will be necessary, one on each side of the Bible cushion, and one at each end of the platform besides, while the desk from which the hymns are announced, generally below the preacher's platform, will also require a couple of lights, one on each side, while

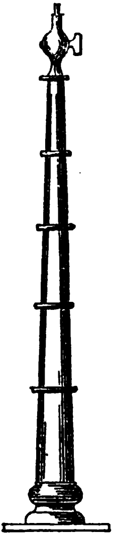


Fig. 88.

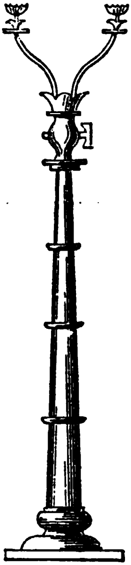


Fig. 89.

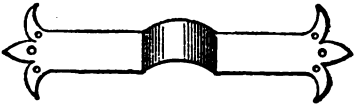


Fig. 90.

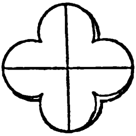


Fig. 91.

should the pulpit be closely backed on to a wall, it will be advisable to add a third light above the preacher's head, so as to furnish him with a good light from behind. Although this light may not often be required, it is just as well to fix it up while the job is in hand. With respect to the principal light for the roof of a chapel, whether sun, chandelier, or corona, the fitter must be guided by circumstances, but we would caution him against the last named, as they do not impart a sacred tone to any building, and the fittings of every building should always be in keeping with the uses to which the building is to be devoted.

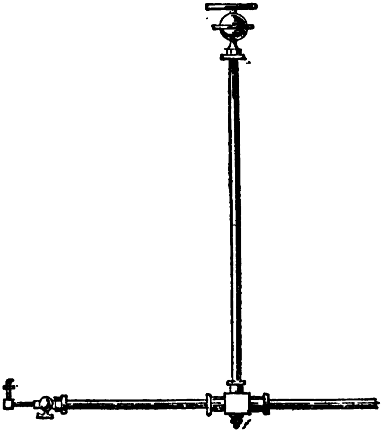


Fig. 92.

Should there be any schools in connection with the chapel, and which receive their supply from the same meter, the supply must either be run from a barrel or from the outlet, a separate stopcock being inserted to enable it being turned on and off, this being, of course, fixed in some convenient place, but out of the reach of the school children, who might otherwise feel disposed to "play larks" with it.

The best lights for the school-room are strong and plain iron 2-light pendants, which the fitter can readily make up himself. Iron piping, employing 1-inch for the rod, and ½-inch or ¾-inch for the arms, will answer admirably. First, get the pieces of the proper length—this depending upon the height of the rooms, the arms of each pendant being 6½ feet from the floor; screw these into the body, which is in reality a diminishing T-piece; on the top fix a cup-and-ball joint, and on the arms fix two swan-neck cocks, when it is ready for fixing up, and will present the appearance shown in Fig. 92. It can afterwards be painted any colour desired—ultramarine blue or chocolate being recommended—which will materially preserve it.

As we mentioned before, in chapels where galleries run round three sides of the building, the building is often fitted up on the composite plan, viz.: "bracket chandeliers," "brackets," and "pillars." In such a case as this the centre of the building is illuminated by means of bracket chandeliers, the galleries by pillars, and the spaces beneath the galleries by brackets; the bracket chandeliers being placed round the sides of the galleries.

When fitting a building up in this fashion, the various supplies must be run beneath the flooring of the galleries, a separate supply being required for each side, and the branches for each light will require to be taken from this supply. The branch pipes down the walls for the supply of gas for the brackets will have to be let into the plaster or stone of the walls, these latter being afterwards neatly repaired, while the main supply will require to be run on the bottom beam in order to insure a fall for the branches.

Having disposed of the general fitting up of a chapel, a few words which will apply to all buildings—be they devoted to religious or secular purposes—may not be out of place here, though it is more in their association with the former that we here touch upon them. Thus, whenever it is desired that a chapel or school-room is to be warmed with gas, a separate supply will require to be put on from the meter outlet for that purpose, but farther on in our work we shall deal with this portion fully.

In cases where wet meters are employed in large buildings, and especially in churches and chapels which are very often closed the whole of the week, a few simple precautions will need to be taken during the winter months. When the frosts are at all severe it not infrequently happens that the meters get frozen up, and especially when the gas is only used on Sundays and the meters are exposed to the elements, as, for instance, when in an area. To prevent this the meter should be well boxed up, and between the meter and the woodwork hay bands stuffed in in order that a certain amount of warmth may be provided, though even this does not always effect the desired end.

Should an accident as this be contemplated it were well for the attendant, some two or three hours before the gas is required, to light up one burner, this being quite sufficient; though a better plan is to light all the jets on Saturday evening and then turn them all out except one, which allow to burn on all through the night, half on, as the gas passing through the meter to supply that one small light will be quite sufficient to keep the drum revolving, and so prevent the meter getting frozen up.

If a light is unobtainable it may at once be concluded that the meter is frozen, and a meter very seldom requires to be supplied with water during frosty weather. Should the meter be frozen take the inlet and the outlet off, next take the syphon screw out, and then pour boiling water down both the inlet and the outlet until the water runs out of the syphon. The meter will then have been thawed, and it must be allowed to run from the syphon until no more will flow, when it will have reached the water-line; the inlet and outlet must then be put on again, with the syphon screw, and all will be found to be in working order again.

As mentioned for the fitting of chapels, there are about three styles of fitting-up churches—subject, of course, to local modifications—namely, pillars fixed to the pews, columns rising from the floor, and brackets or chandeliers for the spaces beneath the galleries, or a combination of both.

But, perhaps, the best plan of illuminating a church —where it is possible to put it into effect—is to have a line of lights on each side of the building running along the top of the string course above the columns and arches. In the following lines we shall describe two systems, including the last mentioned, as they generally apply, leaving any necessary modifications or amplifications to the intelligence and judgment of the workman himself and the exigencies of the building itself.

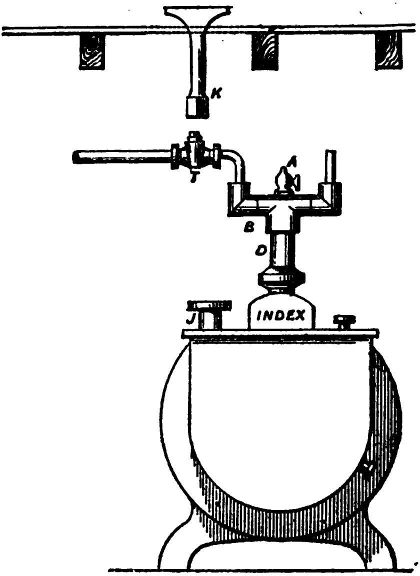


Fig. 93.

The instructions given before for a chapel will apply equally well for a church — taking the difference in building into consideration, with other circumstances; when it is intended to fit it up with brackets, or bracket - chandeliers and pillars, but where columns are employed, the method will be totally different.

At the commencement the meter must be fixed, and at least 2 feet below the flooring of the building, but if this is impossible a syphon will require to be inserted. The meter, however, being placed in its proper position, a barrel must be put on having three outlets—one being for the columns down the aisles, the second for the brackets or chandeliers, if either of these be employed to illuminate the spaces beneath the galleries, and the third for the vestry, if brackets, &c., are not employed.

Should there be no galleries in the church, a couple of outlets only will be necessary—one for the columns and one for the vestry, &c. When the meter is fixed beneath the floor the taps must be fixed on to an elbow, so that a key, similar to that shown at K, in Fig. 93, may be put on; the gas can then be easily turned off or on at each of the outlets without the necessity of going to the meter on each occasion. Of course to get the key in it will be necessary to cut larger holes in the floor-boards than the size of the stalk of the key, and this causes it to sway about if it is not by some means steadied. This can be effected by procuring a stout brass washer, the hole in the middle of which is the exact size of the key stalk, when a good job will have been made of it. Cut the washer in two pieces, drill three holes in each piece for screws, and then fasten it to the flooring with wood screws (see Fig. 94); this will keep the key well in its place and steady.

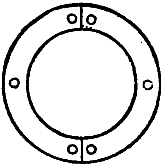


Fig. 94.

The barrels and outlet taps having been fixed, taking care to insert the necessary bye-passes, next proceed to run the various nipples, and in doing this extreme care must be taken to give a fair and direct fall to the meter, while it is understood that the runs must be all of iron piping. Four supplies will generally be found sufficient, the two centre ones being carried on for altar lights; the vestry lights can be taken off of the same supply if thought necessary, though it is better to have a separate one if possible; the branches being struck off to the right and left, if necessary, from the two outside supplies, bends or elbows being put on to the end of each branch, so that it projects through the flooring to enable the columns or pillars to be screwed thereon.

It will be necessary to see that each column or pillar is thoroughly well screwed down, and also that they are so placed as not to be in the way of any one. For the pulpit two lights will be required, and a certain amount of care must be exercised with these that there are no escapes, and that the pipe, if an exterior one, is seen as little as possible, though the best fittings for this purpose are those in which the gas passes through, independent of any exterior or extra pipe.

The main supply pipe for a church can be 1 inch or 1½ inch, as the case may be, this depending upon the size of the building and consequent number of lights required. Plenty of light must be given to the altar, and also to the organist. Three-quarter-inch piping will suffice for the branch supplies, while ½-inch will answer for the light for each of the pillars, and for the branches for the brackets ⅜ will be found sufficiently strong.

We must here remind our readers that all fittings used in ecclesiastical work should be of the very best manufacture, while the patterns and dispositions of them should harmonize, as far as possible, with the architecture and decoration of the building.

There are several churches in England which are illuminated by means of the top lights running along the string course, as before alluded to, among them being St. George's Church, Sheffield, and York Minster, where the plan is a decided success.

It will be seen that this process applies only to the body of the building, as the spaces beneath the galleries, with the organ, must be supplied with either pendants or brackets, the latter being by far preferable. When this method of fitting up is adopted it will not be found necessary to have the meter placed below the level of the flooring, on account of there being no pipes lower than the meter outlet.

When fixing the meter take care to have it in a handy place for turning on and off, but so situated that, though convenient to get to, it cannot be seen by the general public. A barrel must now be made for the meter, and supposing the building to be a large one, needing between two and three hundred lights, about one hundred and twenty-five jets will be necessary on each side of the string course, and about thirty or forty for the organ, vestry, passages, &c. For such a job as this the barrel will need to have three outlets, one for each side of the string course, and one for the other lights, the precaution being observed to insert a bye-pass on each of the outlets.

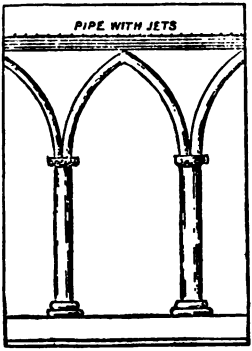


Fig. 95.

When fitting the string course piping, it will be necessary to securely plug the walls for clips at distances of not more than 4 feet, and if bends have to be made to pass round pillars, as will in all probability be the case, the best plan of procedure will be to make a template of iron wire, bending this template as accurately as possible to one of the pillars or columns—generally one template serving for the lot—and then bend the piping to this wire template, taking care not to get this latter at all bent out of its proper shape. Be particular to get the piping of the correct length for these pillars, and in bending do not go about the work in a hurry, but be careful to make the curves easily and by degrees, or the piping may be fractured.

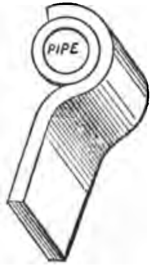


Fig. 96.

The correct length and curve ascertained, then cut or drill the necessary holes, for which purpose the cutting-punch will generally have to be called into requisition. To avoid the pipe becoming split, always have the portion in which the hole is to be punched fixed firmly in the jaws of the vice, and be careful not to have too large a punch, as in that case it will not be possible to get a good thread when tapping the hole. The holes for the burners must be about 6 inches from each other, and if the length of the string course to be fitted be taken in inches, and then divided by six, the number of jets necessary will be at once ascertained. This rule has exceptions, as, of course, in very great measure, the details will depend greatly upon the taste and judgment of the fitter: see Fig. 95. The best shape for the clips holding the pipe is that shown at Fig. 96, and as one plug will support them, they can be made of 1½-inch by ¼-inch iron, while the two screw holes in the wall plugs should be about 1 inch by 2½ inches, certainly not less, in order that a firm hold may be assured. Should the meter be up to the full size required, that is, to take the whole of the lights needed, about three hundred and fifty, the pipe for the three main supplies can be ¾ inch or 1 inch, certainly not larger, while the branch pipes for each of the separate branches need not be over ⅜ inch, and of course iron piping must be employed all through.

With these general directions, which really embrace the whole of the subject, we shall quit that branch of our work dealing with the fitting up of churches and chapels.

# CHAPTER XII.

## *LIGHTS FOR RETAIL SHOPS.*

Shop and Show-rooms — Chandelier Connections — Cup and Ball Joints—Outside Window Rails.

We shall now pass on to the fitting up with the necessary gas apparatus of retail shops, such as those devoted to the sale of grocery, drapery, millinery, and such like, iron piping being the medium employed; also the fixing of shop and window rails, both inside and outside, though it is not usual to have both in the same establishment, still less is it usual to have both in and out lights for the same window, though in some instances it is so, as in the Strand, London, there are a few shops which go in for the double illumination.

Thus, presuming the premises to be fitted up to be a four-story house, containing a shop; a first floor, which may be devoted to private or business purposes; a second floor, in which is a show room; a third floor, on which are situated the work-rooms, and a fourth floor, on which are bedrooms, of course the first thing to do will be to fix the meter. In extensive establishments devoted to business, such as that we have now in our mind's eye, it is general to make a barrel with four or more outlets, thus: one for the supply of the retail shop and show-room lights, one for the work-rooms, one for the bedrooms, and one for the lights of the house, such as staircases, landings, ante-rooms, and such like; or if this plan is not favoured, the same results may be obtained by a double supply, namely, one for the retail or front shop, show-rooms, and work-rooms, and one for the house and bedrooms; but, of course, the workman will be guided entirely by local circumstances, such as style and construction of building, location and dimensions of apartments, position of meter, &c., and will act accordingly, bearing in mind that the fitting up of the front shop is the most important, all the rest being mere matters of detail subsidiary to, and to a certain extent dependent on, that.

Presuming the meter to have been definitely fixed and the barrel on, strike as straight as it is possible from the front shop supply, taking it on either the left or right-hand side of the doorway, which being quite immaterial, after which branch off to the right and to the left, as depicted in Fig. 97, inserting a T-piece in the side which is nearest to the window for a window rail; or if pendants are to be employed carry it up to the top of the window, put on a cross piece, diminishing of course for right and left-hand supplies, and then strike off each way for the supply for each window, putting the necessary T-pieces in where required for the pendants.

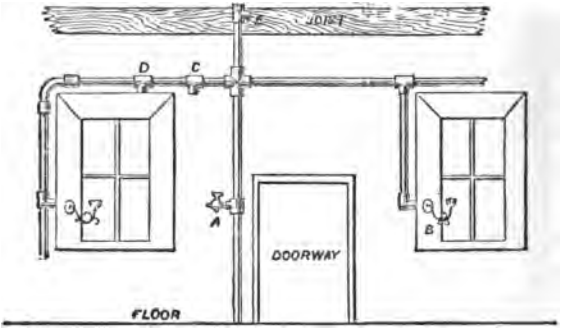


Fig. 97.

In Fig. 97 and similar cases, composition piping may at times be employed with advantage to connect these supplies by inserting a nipple into the T-piece, and afterwards connecting either with a cap and liner or a tinned socket. By a tinned socket it will of course be understood that we mean a socket tinned at one end in order that the composition piping may be soldered into it, the other end screwing on to the nipple; but it is almost superfluous to remark, after what we have previously said, that if it is at all practicable it is far preferable to have the gas runs of iron wholly. The piping having been run as directed to the cross piece, continue the run up, putting a T-piece in for the supply of the shop beneath the flooring, and then from this T-piece continue the supply upwards for the show-room, inserting a stop-cock should it be necessary; but it is almost unnecessary to remind our readers that if a barrel is employed, stop-cocks are but seldom used. The main supplies having been run as far as the first floor as depicted at Fig. 97, next run a supply off from the T-piece, and then from this run the supplies under for the branches for pendants, brackets, or chandeliers, for the illuminating of the sides or the centre of the shop, as the case may be.

Should it be impossible to get a good fall for the meter, as recommended at the commencement of this chapter, syphons must be inserted at various convenient places, and more particularly where the piping is run under the flooring, as it is there somewhat difficult to cut iron piping so as to let the water out when the same has effected a lodgment and insert syphons when once the boards have been nailed down without making a far from pleasant mess, and therefore they had much better be done in the first instance, both on the score of cleanliness and expense.

The necessary supplies for the shop having been satisfactorily run, the various chandelier connections must be put on, or the branches must be so run that they can be easily put up when the fittings are done. We must here counsel the fitter to be particular that the bridge wood between the joists is thoroughly firm. Of course, the plan for running the piping on the floor for these lights will depend very much on the position of the lights and their class, with the size of the shop. Should it be, as is very often the case, a refit up from composition to iron piping, this, where it runs between joists, will have to be laid down in pieces ranging from 2 feet to 3 feet in length, as described in Chapter II. If it is necessary to take up any of the boards, cut them over a joist, as previously directed. The best way to effect this is by punching down the nails on the joists on each side of the run it is intended to cut on, then prise the boardings on each side by means of a chisel to a height sufficient to allow of the board being cut into two by means of a back saw; then insert a bar crossways beneath the board, this resting on the fixed boards on both sides, pushing this bar up as far as possible. Manage it so that the loose end of the board is sprung, then kneel on it or get the assistant to do so, and then give a few sharp blows with a hammer on that end which is fast, when the nails will generally start and the board fly up. This plan is far to be preferred to punching down the nails for the entire distance of the board, and then raising it up by leverage, as by the plan recommended only two chisel marks are made on the board.

Supposing the workman to have to fit up an establishment while the boards instead of being simply nailed down, are fastened with iron dowels, or where they are iron-tongued, they must be cut out bodily; but in cases where they are tongued and grooved they may be got out cleanly and easily by cutting the tongue on one side with a back saw, and then punching the nails down for the entire length of the board, afterwards levering it up from the side where the tongue has been cut. This is somewhat of a digression, though absolutely necessary for the fitter to know and understand.

We will suppose, however, that the supplies for the front shop and other parts of the house have been run, it will be now necessary to fix the various fittings required. Supposing that there is a window rail to be fixed, it must be made to a dead length between the columns on to which it is to be fixed, being carefully adjusted by means of a spirit-level. When fixing a rail to iron columns, the height at which it is to be fixed must first be ascertained, marking its position with a scriber or similar implement, also marking the places for the screw-holes from those in the flanges of the rail. Then take it down and drill the holes by means of the brace described in our preceding chapter, taking care to have a sufficiently diminutive drill, so that the tap will cut a good and true thread in each of the holes. In Fig. 98 is shown a rail similar to that under consideration, fixed on two columns. In such a case as this the supply must be of ⅜-inch copper, taken from the top of the window and clipped as previously directed to the columns with light clips of brass and screws. If a larger number than 6 lights is required, it will be necessary to be larger in proportion. When fastening a rail to the ordinary wooden sides of a shop window, it must be fixed in blocks, and the supply taken as shown in Fig. 97. Rail brackets, star lights and pendants are usually employed for the illumination of the interior of retail shops, and occasionally all these methods are drawn upon according to local circumstances, and in the case of the star lights and pendants always employ cup-and-ball joints for the top, and on no account leave them stiff, as anything striking against them is bound to prove more or less disastrous.

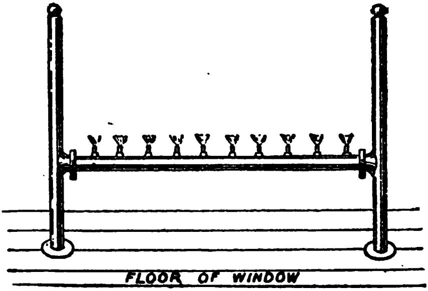


Fig. 98.

When fitting up cup-and-ball joints, always take them to pieces first, and well grease the ball with tallow, also ascertaining that they are thoroughly gas tight, by sucking, before fitting them finally together. When fixing a shop rail, first test its trueness by a spirit-level, and if more than twelve lights are to be fitted, have, if it can be arranged, three supplies, two supplies being ample for a twelve-light rail. For a rail with a double supply we refer the reader to Fig. 99. When there are a couple of counters in a shop, these rails are fixed about central, running between the two counters, at a height of about 6½ feet; but where there is a single counter, the rails must be so fixed as to hang about the centre of the counter. These rails must be fixed on blocks in exactly the same manner as for pendants, the only difference being that instead of the ceiling plates screwing into the drop screw, the latter must screw into the former, the best way to effect this being to solder a small piece of composition piping to the drop screw. A good size for the piece of composition pipe is 18 inches, and after working it nice and straight, it must be screwed into the plates, after which put the rail up so that the two pieces of composition piping will go through the holes in the bridge wood. Afterwards they can be securely fastened to the

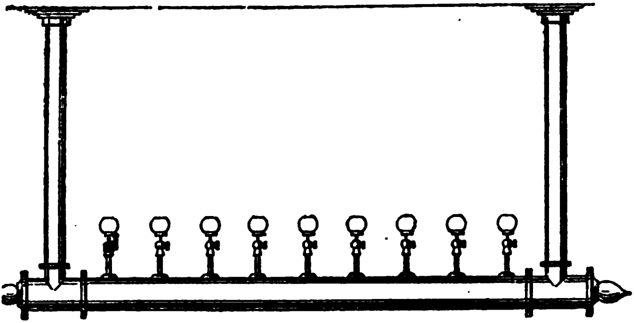


Fig. 99.

pipe above, when the rail has been securely screwed up beneath in its final position.

When fixing a window rail on the outside of the shop, it should always be supported by at least three stays, which should be constructed of piping, screwing into the rail, and also serving as the supply pipes; the construction and fitting being precisely similar to those for inside shop rails, the only difference being that the hanging or upright supply pipes are bent to an angle so as to throw the lights sufficiently far from the window. We have included this method in our work, though the outside rails are but seldom met with, the movable lamps being so much better in every respect. Should the fitter be called upon to fix up an outside rail, a stop tap will have to be put in for each supply.

With these remarks we shall dismiss that portion of our subject dealing with the fitting up of retail shops, the principles being the same generally, the method varying in detail only.

# CHAPTER XIII.

## *BRACKET AND PILLAR LAMPS.*

**Marking Out—"Twigging"—Difference between Pillar and Bracket Lamps—Best Description of Lights for Public Illumination—Fitting up of Lantern—Pillar Lamps.**

In the course of the present chapter we shall give instructions for the fixing of pillar and bracket lamps, and as the methods of each are somewhat different, yet very much akin, we will include both under the one heading, though, of course, treating them separately. Thus, when fixing up a bracket lamp, whether it be for a corner or a flat wall, as a preliminary mark the place which it is intended it shall occupy, and then hold the bracket in position, successively marking the various places for the bolts, screws, nails, &c., which done, carefully plug with wood the places so marked. This accomplished, next fix the bracket up, securely bolting it in its place, put the lamp or lantern in the frame, and then running the supply pipe up the wall till it is within 8 inches or a foot of the top of the bracket.

Should the needed supply be taken from beneath the ground, there must either be a good fall to the service or the main, or a syphon will require to be inserted at the lowest possible joint of the supply pipe. This having been fixed correctly, a cock and union must then be screwed on to the bracket end of the same pipe, and the supply then carried along the bracket arm to the burner of the lantern, using ⅜-inch copper tubing, and making it fast to the arm by binding it with copper wire. As, however, the burner of the lamp will be a foot or more below the supply pipe, it will be necessary to fix a small syphon cock on to the bottom of the burner pipe, as shown in Fig. 101, which shows the lamp "twigging" complete, and will readily explain all that is needed.

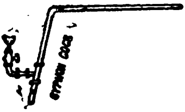


Fig. 100.

The "twigging" being arranged correctly and fixed neatly and closely to the side of the lamp, next put on a lever cock with a long arm, shown in Fig. 100, as this will save the necessity of employing a ladder every time it is desired to light the gas, as this can be done by means of a long lighting stick and hook. The object of the first stop-cock is to act as a check or regulating cock, as when once the light has been regulated by this to the size it is desired to be, there is no necessity to touch it again, although the lamp can be turned on and off by means of the lever cock, giving, however, always the same amount of light. In Fig. 101 is shown the bracket lamp complete. Should the supply be taken from that laid on for the house or shop, and not from the main, it may of course be necessary to syphon it then, but in such cases the fitter will have to exercise his own judgment as to whether or not it is absolutely necessary.

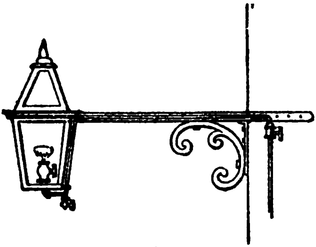


Fig. 101.

When fixing up a pillar lamp it will be found that very little twigging is necessary, the pillar being cast hollow, with generally a length of ½-inch iron tubing inserted up the pillar. With a lamp of the description under notice, the pillar must first of all be fixed; and care must be taken that this is done on a firm foundation, such as stone, bricks, or concrete, the last being the best. Having got the pillar into the proper upright position, next plumb it to see that it is perfectly true; and should it not be so, pack it with some good firm substance until its proper position is attained. This having been satisfactorily accomplished, next get the supply pipe of the proper length, which should be so that it just reaches the top of the pillar, leaving about half an inch of the screw thread visible through the top, and about 4 inches of piping below the opening of the chamber at the bottom. Should it be possible to obtain a fall to the main pipe, a bend can be screwed on to the bottom of the supply pipe and connected direct with the service. If a fall cannot be obtained, a coil syphon, similar to that shown at Fig. 102, must be put in. To effect this, screw a T-piece on to the supply, and from the centre of this T-piece connect it with the supply from the main or the service, as the case may be, and then on the bottom of the T-piece connect the coil syphon, which may be made of either lead or composition piping, but the precaution must be taken of well bricking it round to preserve it from all injury. It having been securely fixed, next screw a socket on to the piece of piping which projects above the top of the pillar, which should form a flange to prevent the pipe from dropping. Now into the socket screw a half-inch nipple, and on to this fix the check cock, which should be male and female, the latter screw being ½-inch iron, and the former ⅜-inch brass. Now screw on the lamp cock and the burner socket, when the job will be complete. The check cock, by the way, must be fixed in the opposite way to the lever cock, when the whole will present the appearance shown at Fig. 103.

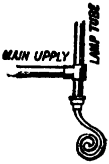


Fig. 102.

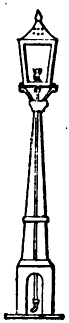


Fig. 103.

And here we will make a slight digression to offer a few remarks upon the description of light best adapted to public illumination, for which purposes bracket and pillar lamps are very commonly employed. For the lighting up of public thoroughfares we would recommend that the pillars be 10 feet in height, and placed about 120 feet apart on each side of the roadway, but not opposite to each other, and that they are fitted with round or square lanterns of the usual sort, larger at the top than at the bottom (similar, in fact, to Fig. 103), though with almost a flat top. They should be glazed with opal or enamelled iron to deflect the light; and the bottom should be glazed also, and fitted with a door to admit the lighting rod, sufficient but not unnecessary ventilation being provided for the lantern, so that the rain will not fracture the glass when this latter gets hot, or the flame flicker, which otherwise will be the case. These lamps should be provided with lights of 30-candle power, which will generally be found ample for the majority of streets. However, to resume the technical portion of our subject.

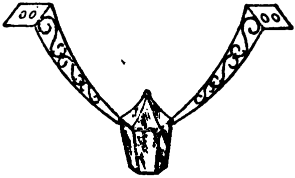


Fig. 104.

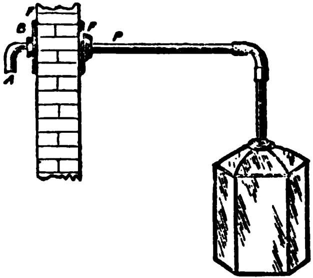


Fig. 105.

For such large bracket lamps as are seen on the exterior of large establishments, such as public-houses, theatres, music-halls, &c., there are a variety of designs to select from, four of which of the most generally employed are shown at Figs. 104, 105, 107, and 108.

When fixing such a bracket as Fig. 104, first of all mark the holes from the flanges of the bracket, and then proceed to cut the necessary holes through the wall in to the room on the inner side, and then fix with four screw bolts, not omitting to put back plates or washers on each of the bolts to allow of the nuts to bed against when the tightening up is done. This done, twig up the bracket as previously directed by running copper pipe inside one of the bracket arms, and then securely binding it down with copper wire at intervals of about 6 inches. Unlike those lamps previously treated, check and lever cocks can in these be entirely dispensed with, as the lantern is in the majority

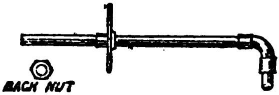


Fig. 106.

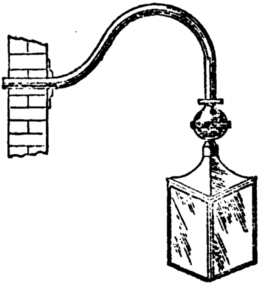


Fig. 107.

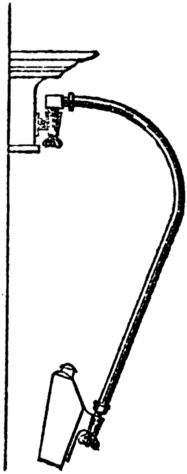


Fig. 108.

of cases supplied from that laid on for the house. When such is the case, a cock for turning the gas on and off must be fixed in some handy situation, though at the same time out of the reach of youngsters and mischievous boys. In conclusion, place a syphon cock at the bottom of the burner tube, and should it prove necessary syphon the supply likewise. In the Fig. 105 the supporting arm also serves as the supply barrel for the gas, while it forms the bracket, or rather suspension. In this F F are two flanges, one of which is screwed on to the pipe for a distance of about 1½ inches down, after which bed the flange down tightly, then screw on a socket, and afterwards into this screw a piece of tubing sufficiently long to pass through the wall, and enable it to come flush or level with the inner wall, as shown at Fig. 106. On this place the second flange, but which must not be tapped for screwing on, but instead slip on, being then tightened up by means of a back nut, while a diminishing elbow is also screwed on for connecting the supply, which can then be effected by means of a nipple and union. When putting the flange, elbow, &c., on, the wall on the inside must be so cut away as to admit of the flange and back nut being let in, so that when the elbow is screwed on it will be close up to the inside wall, although in Fig. 105 it is depicted as standing out, in order to show the flange and back nut more plainly; P is the piping for the bracket, F F are the flanges, B is the back nut, and A is the elbow. The inside twigging for the lamps, shown at Figs. 105 and 107, is taken from a diminishing elbow screwed on to the supply inside the lamp, which projects about ½ inch through the lamp cap, C, but not sufficiently for it to be seen through the glass. In Fig. 107 the lamp is fitted with a ball joint, and the plan of having these lamps constructed with cup and ball joints is one to be highly commended. This applies especially to hall lamps, both for public and private establishments. In Fig. 108 is shown a lamp designed for the lighting up of shop windows on the outside. When fixing up these lamps the stop-cock needed for the supply must be placed somewhere handy in the shop, this description of lantern not being supplied with them. At the top and bottom of the outside supply pipes swivel joints must be fixed, these being supplied with wing or fly nuts, in order that when the light is not needed, the lanterns can be readily disconnected. These lamps usually need no twigging, the only thing to do being the fixing up, the manufacturers of this description of lantern always sending them out complete. When putting them up take the precaution to have the supply sufficiently ample, a ⅜-inch pipe being usually sufficient for a single light, composed of an Argand burner. Be particular to have the back, B, strong and well fixed, as from the daily taking down and putting up it undergoes a large amount of wear and tear.

In large establishments where these lamps are to be seen in a row of four, six, eight, or even a dozen or more, they are attached to a rail or rod, the supply being given at each end, and in the case of a large number, from eighteen to two dozen lanterns, a third supply effected in the middle, so that the light may be equalised all along the line. The fitter must take the precaution, when fixing a row of these lamps, that the rail is put up thoroughly firm and well stayed, as otherwise, on a gusty day, they are apt to be blown down.

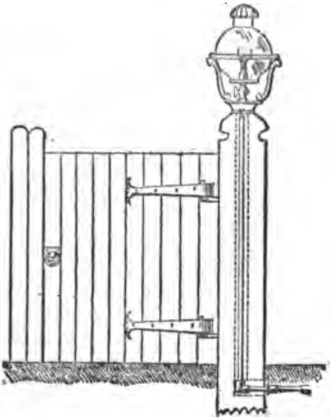


Fig. 109.

In concluding this chapter we shall give the particulars of a job which is but seldom met with in professional practice, viz., the fitting of a lantern, without the aid of bracket irons, upon a stone pillar, as shown at Fig. 109, being such as are met with at lodge-gates, stables, &c. In such circumstances, it is usual to fix the lantern into a frame, which in turn is screwed on to a piece of 1½-inch piping, this being driven down the entire length of the pillar, or, at least, of such portion of it as is above the surface. Of course, to effect this preliminary, it will be necessary to drill the pillar from the top to a depth of 6 inches below the surface of the ground. This will prove a somewhat hard and long job, the description of pillars which are usually surmounted with this kind of light varying from 8 to 9 feet in height, and therefore four or more drills will be required with the same sized head, but of varying lengths, the first being 2½ feet, the second 4½ feet, the third 6½ feet, and the fourth sufficiently long to finish the drilling through the pillar. When working, commence with the shortest of the four drills—for a very tall pillar five or six drills will be necessary—cutting a hole by striking with a sledge-hammer, while an attendant holds the drill, which must be turned round a little way for every stroke of the sledge. In some instances the drill cuts better when wetted, at other times when dry, this, of course, depending upon the nature of the stone to be operated on. Although this sort of work does not come strictly within the province of the gas-fitter, still it very frequently happens, especially in country places, that the fitter has to do it, and it is for that reason that we give the necessary instructions. All the required drills must be about ⅛ inch larger than the outside diameter of the piping—which must be iron—it is intended to run through the pillar, and while in process of cutting the hole will need to be often cleared out, whether it be cut with water or without. When drilling, having gone as far down the hole with the first sized drill as possible, take up the next of the sizes, and so on with the others, until the desired hole has been drilled out. The exact depth of the hole from the top must then be ascertained, and the place marked on the side of the pillar, and from this place a hole must be cut in the pillar to meet the hole already cut in the centre, this latter being about 2 inches in diameter, or at any rate, to admit of a ½-inch elbow being inserted. This drilling accomplished, next procure a piece of 1¼-inch tubing, screwed for a depth of 1½ inches at one end, and on this fix a socket, and then with a wooden mallet drive it down the hole in the centre of the pillar, until there only remains about 1¼ inches of the screwed end of the piping visible at the top. If this piece of pipe is about an inch shorter than the hole into which it is driven, it will be about right. Having about an inch and a half above the pillar, allow plenty of room at the other end to insert the elbow. The pipe having been got into its place all right, the socket must be screwed off, this having been only put on to protect the thread from injury. A wrought-iron flange of about ⅜ inch in thickness, and about 3 inches over, must now be screwed on to the piece of piping which projects from the side of the pillar, and then the lamp frame must be screwed on, the boss of this being tapped out to the desired size, after which it must be twigged with ½-inch iron piping. Now screw the ½-inch elbow on a piece of pipe and insert in the hole at the bottom of the pillar; next put in a piece of ½-inch iron tubing down the centre of the pillar, screwing it to the elbow at the bottom —the piping being sufficiently long to allow it projecting about ½ inch above the boss of the lamp frame, in order that a check cock can be screwed on; after which, fix on the lever cock, burner tube, &c., and this portion is finished. At the bottom of the pillar the supply must be connected with the service by means of a long screw, as shown at Fig. 109. The dotted line in the illustration denotes the hole down the pillar, while the ½-inch supply tube inside, with the elbow, and the long screw which connects the service are all represented, so the fitter who may chance on such a task as the foregoing should be in not the least doubt as to his method of procedure. This pretty well exhausts the subject of bracket and pillar lantern fixing, as although there are an abundance of patterns and styles, still, in the main they follow the lines given above, and any fitter who can put up those of which we have treated, will not be at a loss with any other he may have.

# CHAPTER XIV.

## *FESTIVAL ILLUMINATIONS, ETC.*

**Taking up Supply—Fixing of Apparatus—Staging—Temporary and Portable Lights—Lime-light, &c.**

Before quitting the portion of our work dealing with illumination, and passing on to that division treating of warming, cooking, and the use of the various tools and apparatus required by the gas-fitter, we purpose offering a few directions upon a few matters which may have been passed over in the preceding lines, but which, though slight in themselves, and to a certain degree unimportant, should still be included in a manual dealing practically with such a subject as gas fitting.

Thus, in fitting up illuminations for royal and other birthdays, or for rural fêtes, &c., the supply is taken generally from the main in the street, or if the device is to front a house, the supply is taken from the outlet of the meter, a barrel having been previously fixed on. When the device is at all large, it is best to have a double supply of gas, one at each end, otherwise the lights at the extremities are liable to be weak, and if it is at all a windy night they will become extinguished—to a consequent marring of the effect. In the case of oval, circular, or letter devices, it will usually be found that a centre supply will be quite sufficient, ¾-inch tubing sufficing for these, and 1-inch pipe for the larger. In glass pieces greater care will of course have to be exercised, both in fitting up and in adjusting the supply of gas, in order that the glass drops may not be shattered. In fitting up gas devices in the front of a large hall or mansion, the piping is connected with the main in the street, or if the meter is sufficiently large and powerful, the stationary piping can be temporarily disarranged, and a barrel put on the outlet; and where the gas consumed has to be paid for by the renter of the house adorned, this will generally be the plan which will have to be adopted, unless arrangements are made with the gas company to the contrary. The supply pipe having been run and firmly fixed, diminishing T-pieces and elbows, bends, &c., must be fitted in where necessary to the device itself, and the whole must be firmly secured before lighting up.

In illuminations which have to be fixed up on open spaces, such as lawns, public roads, &c., where there are no houses to serve as a supporting background, the aid of a carpenter will have to be called in to erect stages, on to which the device can be hooked or clipped.

And here we must warn the fitter that all places likely even remotely to come into contact with the flame must be covered over with thin sheet iron, while, should boarding be put up on which to display the device, it must be covered entirely behind the illumination with sheet iron, and the general effect will be vastly improved if the wood and ironwork are painted black all over. Before lighting see that the jets are all open and free from dust, while the glass drops should also all be thoroughly clean and dry. Of course, in the details for the fitting up of temporary illuminations, the fitter will be entirely led by local circumstances.

Although this description of work is very seldom, at any rate so far as the metropolis and other large towns are concerned, done by the ordinary tradesman, still we have thought it well to include these few remarks, as it frequently happens that in country places the work has to be done by the local fitter, with the assistance of a few labourers. In London, this work is generally contracted for by large contractors, as Messrs. Defries and Son, of Houndsditch, who carried out the major portion of the decorations on the recovery of the Prince of Wales from his long illness; on the marriage of the Duke of Edinburgh; and who now on royal birthdays and other festive occasions, do the work; while the devices to be seen in glass at many of the London theatres also emanate from this firm, who also supply Venetian poles, flags, shields, &c., and, in fact, everything required for such festive occasions. However, to return to our subject.

It often happens that a person wishes to connect his ordinary chandelier or bracket gas supply with a small reading lamp on the table, or small gas stove in the grate, especially in the summer time, when the heat generated by the gas is far from pleasant. For either of these purposes a length of flexible tubing—that having a spring inside being the best—and a fly-nut union at each end answers all purposes. A good gas standard for reading by, with shade complete, will not cost more than 3s. 6d., while the price of gas stoves depends upon their size, from half a crown upwards. Of course the tubing and fly nuts will in each case be extra items.

Of course, any temporary or portable lights can be arranged in the same manner, the precaution being taken to have the tubing not too short or too long, and that the fly nuts fit thoroughly well on to their respective screws.

We shall now close these somewhat discursive remarks with one respecting lime light, which in the case of theatres and music-halls will frequently be required, and also, of course, will have to be arranged by the gas man. Thus, when lime-light holders are employed, they must be made of copper, while the connecting pipes must also be made of copper. Great care must be exercised in jointing them, as in the first place oxygen gas is very dear, and, in the second, is not very safe when it leaks, so the workman must pay especial attention to the fitting.

This will conclude our work so far as it relates to illuminating purposes; we shall therefore now, in our appendix, as it were, have somewhat to say respecting the fitting up of warming and cooking stoves, without which no work upon the subject of gas fitting would be complete, besides which we shall also touch briefly upon automatic gas lighting.

# CHAPTER XV.

## *THE FIXING OF COOKING AND WARMING STOVES.*

**General Remarks — Gas Heating Stoves — Necessity of Separate Supply—Ring and other Burners.**

Before proceeding to treat of the fitting up of gas cooking and warming stoves, we shall make a few remarks bearing generally upon the question. Although both cooking and warming by gas was long looked upon with scant favour by large numbers of persons, they are every day growing more and more in favour; and there is no doubt that if the stove be properly constructed and the supply of gas good, this method is far superior to coal for both purposes, and in the summer time for cooking more especially. The gas flame in gas cooking stoves differs materially from the ordinary gas flame employed for illuminating purposes. And it is just as well to bear this fact in mind, as some people object to cooking by means of gas for the reason that they are only acquainted with it as employed in illumination, in which much soot and other objectionable products of combustion are thrown off. In the gas cooking stove the flame is more perfect, the combustion being more perfect, though the temperature is also far higher, so that by this simple change a large saving of gas is effected, with higher results and an almost total absence of soot, &c. To effect this change all that is necessary is to mix the gas with a sufficient quantity of air, by means of an atmospheric burner, the general construction of which has been already described, before the former reaches the burner, and then to subdivide the flame itself. This mixture of gas and air was long known in the form of the Bunsen burner and the blow-pipe, though it is only of recent years that it has come to be generally applied to gas cooking stoves; and it was owing to the fact that in the old form of cooking stove all the heat was given and no air that cooking by this means got so much into disfavour. Briefly summarised, the advantages which gas possesses over coal for cooking purposes may be summed up thus: It is always ready, and can be turned off or on in a moment; it is very clean, and deposits no soot if properly lighted; the heat can be regulated to the requirements of the occasion; it requires no attention; it is cheap and economical; it preserves the flavour of meat; and it saves both time and labour.

To take the question in its greatest, *i.e.* economical, point of view. A ton of coals (Wallsend) in London will, on an average, cost 26s., and this will feed a small kitchen range for a couple of months, the outlay thus being 13s. per month; to this must be added a shilling each month for firewood, which in the metropolis costs 3s. 6d. per 100 bundles, this bringing the cost up to 14s. a month. The cost of gas for doing the same quantity of cooking amounts, at 3s. per 1,000 cubic feet, to about 4d. per day, or 10s. a month, to which 8d. per month for the rental of a gas stove, where one is not purchased, has to be added. This amounts to 10s. 8d., making the saving each month upwards of 3s. And here we may mention that where stoves can be hired from the gas companies it is cheaper than purchasing, as the companies keep them in repair free of expense to the hirer. The advantages of gas are, of course, felt more in the summer months, when coal fires prove objectionable, and, to those employed in the kitchen, almost intolerable; and the atmosphere of a kitchen where gas stoves are kept contrasts very favourably at this period of the year with those where coal fires are kept. It is impossible here, for obvious reasons, for us to single out any special form of cooking stove as one to be commended; their number is legion, and as they are all more or less efficient, we must leave the purchaser to make his own selection. We have already described the process of fixing them, and will therefore conclude this portion of our subject by offering a few "wrinkles" which should be borne in mind when ordering one. Care should be taken that means are provided for supplying a sufficient quantity of air for mixing with the gas before this is consumed in the flame. The air is admitted by means of a number of small holes or slits opening into the tube along which the gas passes, and in rushing forward under pressure the gas draws the air with it into the flame.

To obtain a maximum amount of heat out of a given quantity of gas, it is necessary to add to it a certain amount of air. When the gas rushes—on being turned on—rapidly towards the flame, a greater quantity of air is drawn in through the holes or slits than when the gas passes at a slower rate. This to a large degree regulates the supply of the air, and it consequently at times happens that either too much or too little air is admitted. A small quantity of gas passing through the pipe cannot exercise the necessary force to create a vacuum into which the air could be drawn, and as a result, the heat derived from the flame is far below what could be expected; in fact, it ceases more or less to be a blue flame, and consequently becomes a luminous and comparatively cold, or possibly a smoky flame. The other provision is made for the due controlling of the air supply, and since an excess is the lesser of two evils, it is far to be preferred to have the slits or holes a trifle over large than the reverse. And here we will give a word or two as regards lighting: when lighting an atmospheric burner, that is, one in which air and gas are blended, and in which a blue flame is produced, the gas should first be turned full on, and then regulated to the heat required, otherwise the gas is liable to "light back," *i.e.*, to light within the tube without mixing with the air, giving rise to imperfect combustion with the gas, and causing the burners to smoke and smell. In such a case, the only remedy is to turn the gas right out and then to relight it. With respect to cooking stoves generally, it may be noted that the larger the oven or roaster is, the more convenient it will prove. This oven should be well provided with movable "girds" or trays, and should have one metal tray for the reflection of heat, by which the tops of pies, &c., may be browned; and also with a ventilator which will allow of the various gases to escape. A gas stove which is only fitted with a small oven, or with one which is divided into a number of parts without the means of being enlarged, will be found exceedingly inconvenient should it be desired to cook at all a large joint.

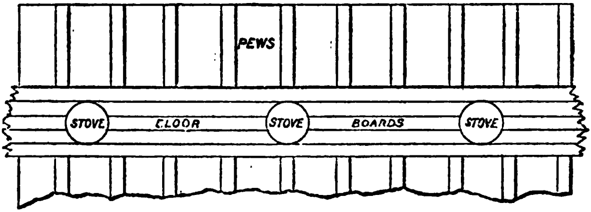


Fig. 110.

With these few remarks, we shall dismiss the subject of gas cooking stoves, and pass on to the remaining portion of our chapter, namely that dealing with the heating up of a church or chapel with a gas heating stove, the principles of which can be applied to almost any other building, while the connecting of those for ordinary sitting-rooms has been already described.

In Fig. 110 is represented the one side of a church or chapel fitted with stoves supplied with atmospheric burners similar to that shown at Fig. 111. These are made from ¾-inch iron tubing, and the air chamber is of cast iron and screwed on to the end of the ring. Should the floor of the building be an encaustic one, the holes in the flooring to which to fix the burners will require to be about a foot in depth and about 16 inches in diameter, while round the top of the hole a cast-iron ring must be cemented in level with the flooring. This ring must have a ledge cast on it, so that a cast fancy grating will be able to rest on it and so cover the hole level with the remainder of the flooring.

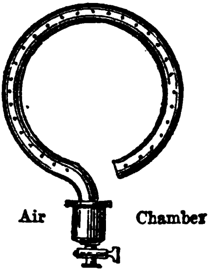


Fig. 111.

Where the flooring consists of joists and boards, the hole in the flooring will have to be covered over with sheet iron and the lath and plaster protected with a thick coating of plaster of Paris, say about an inch in thickness; but we may here say that we do not favour this method of fitting, as the heat thrown out by the burner is very often sufficient to set fire to the joist, but it is frequently adopted on account of its cheapness and simplicity of fitting up. This will not of course apply to encaustic floorings.

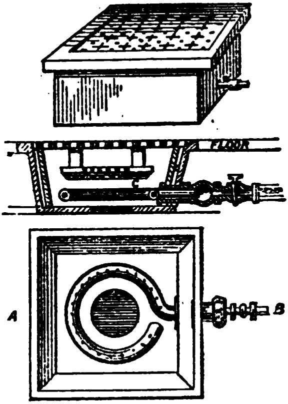


Fig. 112.

One of the best stoves for wooden floorings is Gill's patent gas, which is intended for the heating of churches and chapels solely. In this there is a chamber between the inner and outer case or skin, which is fitted with a non-conducting composition, which renders the stove perfectly safe even though it fits quite close to any woodwork. These stoves can also be obtained of the exact size to enable them to be fitted in quite level with the flooring, between the joist and the bed. They are easily fixed and not at all expensive. Of course there are plenty others from which the purchaser can select, and we do not mention these as being the only stove adapted to the purpose in view, but simply as being one which we know to be good. With a view to estimating purposes, we may mention that six of these stoves, as shown at Fig. 112, will warm a chapel or other public edifice, 30 feet in width by 60 feet in length, at a cost of about 2d. per hour, or very little over that figure.

When fixing this, or, in fact, any other pattern stove for warming purposes, care must be taken that a direct and separate supply from the meter is provided, each having a separate tap, as shown at Fig. 111, so that if the heat becomes excessive, one or more of the stoves can be turned out, and the heat reduced. When fixing these stoves between floor-boards it will be advisable to make a small hole in the ceiling below—presuming, of course, that there are rooms or cellars beneath—for ventilating purposes, but it must not exceed ½ an inch in diameter, as although advisable, it is not absolutely necessary. When running the piping, which must be of iron, take it straight along, and then strike off at the points where the ring is to be fixed, as shown at Fig. 113.

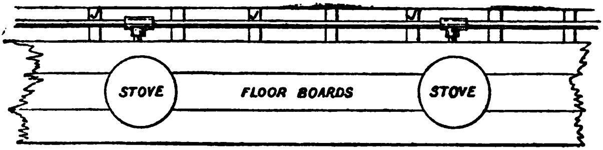


Fig. 113.

The ring burners shown at Fig. 111, will warm a room 14 feet square, and in fitting up any place, large or small, with these burners, this may be taken as a general rule and worked from accordingly. The burner shown in this illustration can be utilised for many other purposes beyond those already described, such as for boiling in cooking stoves, heating baths by gas, heating bookbinders' tools, &c., the size, of course, being modified to meet the respective requirements, and if properly constructed they will be entirely free from both smoke and smell. For those requiring further particulars upon them, their construction, &c., we must refer them to Chapter X., treating of the fitting up of theatres, music-halls, &c.

The above principles will be sufficient to carry the fitter through almost every branch of his trade, a due regard being paid to local circumstances, &c.

# CHAPTER XVI.

## *AUTOMATIC GAS LIGHTING.*

The Electric Light—Advantages for Municipal and other Public Bodies—Batteries.

THE vast and rapid strides which the electric light, and, in fact, electricity in all its multifarious forms in general, has made of late years, has no doubt put our gas companies and inventors on their mettle, and we venture to think, with a certain amount of success, for although four or five years since we were told on all hands that gas was "effete," "played out," and a variety of other commonplaces applied to it, still the fact is patent that never before was the metropolis so well illuminated as now, and this largely by gas, the improved apparatus making a great difference in the past and the present. Following the good example thus set, our municipal and other authorities, not forgetting the caterers for the amusements of the people, have been nothing loth to take advantage of the improved appliances at their command; the consequence being that many of our large theatres and public halls are now lit automatically, as also, in different towns, some of the streets, the idea of automatic illumination having no doubt been borrowed from the practice of electric lighting.

In our illustrations we introduce several of these useful appliances for the lighting of lamps or gas by means of the electric current. A very simple arrangement of wires through which passes a current from a small battery is shown at Fig. 114; A is here the lighting point, and C the contact breaker or push. Two wires are necessary. D is the connection from the gas tube, through the push, and on to the lighting point. Figs. 115 and 116 are batteries, with lamps to light by means of the electric spark. In Fig. 117 the contact is effected when the gas is turned on, and thus it is lit automatically. As this work is not intended to deal with electricity, we shall forbear from explaining the illustrations, but simply illustrate them for the convenience of those readers who may purpose to adopt them. In Fig. 117, Leclanché cells of the No. 3 size will be found to possess quite sufficient power to provide the necessary spark. A contact and fuse are shown at Fig 118. The points of ignition are composed of platinum, which metal will be found to glow under the electric current. Any electric bell-fitter will undertake the fixing up of any of this apparatus, and the expense will not prove excessive.

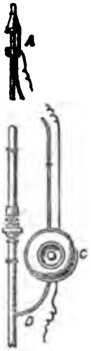


Fig. 114.

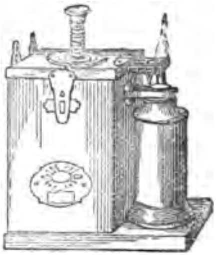


Fig. 115.

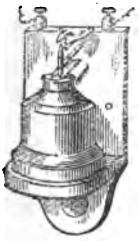


Fig. 116.

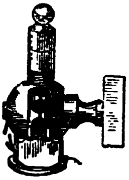


Fig. 117.

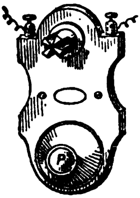


Fig. 118.

# CHAPTER XVII.

## *A WORD TO CONSUMERS.*

Advice respecting the Meter—Use of the Meter—Gas Regulators—Leakages or Breakages—Automatic Governors—Governor Burners—The Wenham Lamp.

In this present chapter we shall deal with various matters connected with gas fitting. Properly, it should perhaps be more particularly addressed to householders, as it treats of meters and the way to read them, of governor burners, of the hydraulic slide gas regulators and governors, and the precautions which a prudent householder should take against accidents and to insure convenience and economy in the use of gas. Any one who has read as far as this chapter will know, of course, that meters are of two kinds, wet and dry. Each has its adherents, but we think now a more general preference is given to the dry meter. The ordinary form of this is well known and will be found at page 21, *ante*. One word only of advice, "Do not tamper with the meter." If gas escapes and the strong and unmistakable odour fills the air in the vicinity of the meter, call in a gas-fitter and have it removed, writing also to the gas company, who will replace it quickly. Open the doors and windows if the meter is placed at the end of a passage, or in any way enclosed, for though gas alone under ordinary conditions is not explosive, it is when mixed with air highly dangerous. The proportions of air and gas which make the most explosive compound has little interest for particular uses, and we are glad to find that gas and air may be so mixed that explosions of a harmless kind may be repeated every moment, and the dangerous mixture made safe and useful. For it is this union of gas and air which gives force to the popular gas engine, an appliance most useful for small powers, and daily coming into more general use. How it stratifies, and in what proportion it may be mixed, at what point it should be fired, are questions which the legal and the technical world has had for long before them, but on which their opinions are still divided. The point, however, which is of more particular interest to the general reader is one that cannot be too clearly brought to his mind. It is that this useful servant, so clean, so admirably adapted to the wants of the age, may become, if neglected, the most dangerous master. Let no escape of gas, therefore, however slight, pass by unnoticed, but take immediate steps to have the leakage stopped. The meter, even if the connections are perfectly sound, may neglect to register. Notice should be given to the gas company of this if discovered by the occupier. If left and it is noted by the gas inspector the rate of payment is adjusted by a reference to the last quarter's account, or rather the account for the corresponding quarter of the past year. The gas companies generally take good care of themselves, so the consumer is not likely to gain anything by his neglect to report the inaccuracy of the meter.

The meter, however, does not control the supply of gas, but measures it as it passes through. A larger meter than one fitted for the exact number of lights burning at one time is always fixed. It follows therefore that unless some control is exercised by limiting the supply by means of the key, turning it partly on and off as required, there must necessarily be waste. Let us suppose that 20 lights are fitted in a house. They will not all be likely to be lighted at once, the supply pipe, however, is fitted to allow for the full quantity of gas to pass through. If one or two are lighted the gas often "sings," or comes through the burner with a rush which wastes the gas and decreases the illuminatory power. This may be partly checked by regulating the gas at the supply, a much better practice than to do so by the tap. For as the pressure in the main varies, or as lights are turned out along the service, the roaring or singing is sure to be heard, and it is the consumer who has to "pay the piper." There are many kinds of burners said to check this tendency. These governor burners vary in efficiency; they are, however, constructed on scientific principles, and those of Sugg of London, Bray of Leeds, or Heron of Manchester may be recommended as reliable in such degree that a burner can control the consumption of gas. The best method of control, however, and one which is cheapest in the end, is to have a governor fixed. These are of two kinds, mechanical and automatic. The best known regulator of the first pattern is that made by Carnaby of Broad Street, Bloomsbury. This is an appliance acting by a long wire or chain on the key of the main tap of the gas supply, having a dial with degrees marked from "off" to "full on." This regulator is placed in any part of the counting-house, hall, parlour, or even the bedroom, and the supply of gas is therefore fully under control.

In event of a breakage of gas fittings or leakage, the gas may be in an instant completely shut out of the house. The supply of gas is by this appliance regulated before it passes through the meter. The exact quantity which the burners require and no more being admitted, perfect combustion is obtained and a very considerable saving is undoubtedly effected.

Automatic governors—it would be invidious to select from the dozen or so of manufacturers who have devoted themselves exclusively to this branch of gas engineering—effect a similar saving by a self-acting valve or governor.

An inverted cup is used, sealed in annular trough filled with quicksilver. To the centre of the inverted cup attached is a simple spindle, at the bottom end of which is a double-beat valve, a high pressure raising the inverted cup and thus closing the valve, while a low pressure allows it to fall, thus opening it.

Let us suppose then that, say, 50 out of 100 lights be turned off, there will be a corresponding increase of pressure on the inverted cup, raising and thereby closing the valve partially, so that for every light turned off or on, or any increase or decrease in the street mains, there is a corresponding opening or closing of the valve in the governor, the pressure at the burner thus being nearly the same under any circumstances, which undoubtedly effects a great saving.

Governor burners are constructed on a similar principle, but they are too complicated for general use. The best of the long series of governor burners are those where the pressure of the gas is regulated or checked by passing through a network of orifices or passages before issuing out to be lighted. Many of our scientific gas engineers have brought their energy and enterprise to bear on the improved construction of burners, but the latest achievement, the Wenham burner, invented by a civil engineer of repute, bids fair to eclipse most of them by its convenient form and splendid illuminating power while the consumption of gas is kept under.

The Wenham lamp, named after its inventor, Mr. F. H. Wenham, C.E., of Westminster, marks a distinct departure in the method of burning gas for lighting. The gas is burnt downward instead of upward, and the common air is heated before it reaches the flame. A gas-flame consumes about fifteen times as much air as it does gas, and in this lamp care is taken to heat this air as much as possible before it comes into contact with the gas. It is claimed that the lamp increases the illuminating power of common gas from 200 to 400 per cent., and this, too, without charging the gas with additional hydrocarbons. The flame has no invisible or blue part to it, but over its whole area is intensely luminous, and is of the form of a ring or cup of light, burning without flickering.

The external appearance of the form most in use is given at Fig. 119, but it is, of course, made in various shapes and sizes for different places, some of the patterns being tasteful and luxurious.

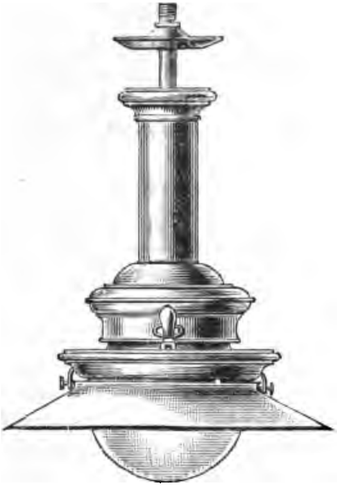


Fig. 119.

In our diagram of the section of the lamp, Fig. 120, A is the air inlet, B the regenerator: this is somewhat massively made in iron, and takes up the heat of the gas-flame burning beneath it to communicate it to the incoming air. A cylinder, C, conveys the heated air to the burner through the perforated discs; D is the burner; E, the flame; F, the reflector; G, the fastener of the ring, J, which carries the lamp-glass, K, and has a hinge at H. These lamp-glasses gave the company some little trouble at first, as they were required to be very light and thin, but a Paris firm has arranged now for the supply of any quantity. The ends of flower-shades were first used for the purpose. The chimney is at L; M is the gas supply pipe, and N the heat disperser.

A section of the burner, Fig. 121, is also given, as it illustrates the principle of combustion. Mr. Wenham contends that to get the best light the gas must issue in a series of streams rather than in a thin sheet; the air gets at it better.

When the flame of this lamp is turned on so that the little projections begin to appear at the outside edge of

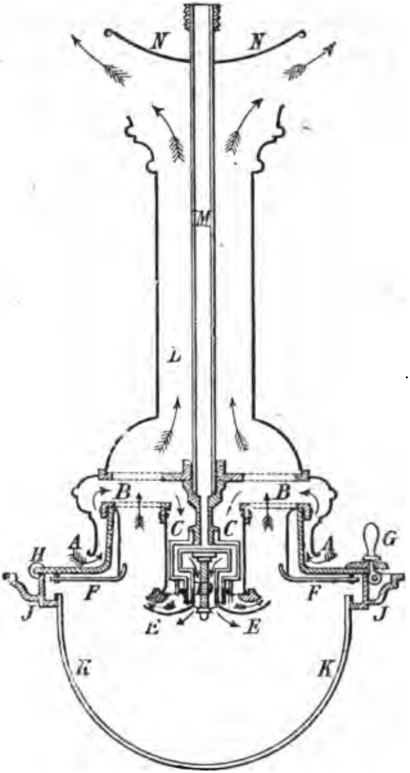


Fig. 120.

the ring of light, the lamp is giving the maximum illumination. In this diagram, Fig. 121, A is the porcelain burner, held in position by the ring, B; C is a perforated disc, and D a perforated button; E, the stem supporting the button; F, the gas-way to the burner; G, a perforated dome; H, a ring secured by a bayonet lock; K, the external cylinder; L, the gas supply pipe; and M, the flame. The gas issues in a horizontal curve from a ring of holes in the burner.

It will be long, we expect, before gas as an illuminant is extinguished by its younger rival, the electric light. Those who, relying on the prophetic utterance of stock and share brokers that gas would be "totally eclipsed," put their money into the fascinating snare, furnish an amusing example of the well-worn proverb that "It is not safe to prophesy until you know."

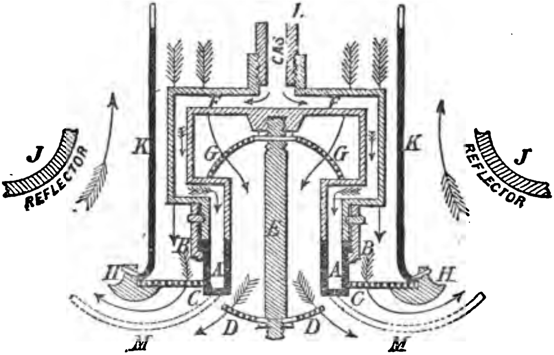


Fig. 121.

# CHAPTER XVIII.

## *SUPPLEMENTARY.*

Recent Improvements in Burners—Incandescent Systems—Selection of Chimneys and Globes—Clear, Ground, and Coloured Glass Globes—Increased Use of Gas—Recent Appliances for Use in Cooking and Warming by Gas—"Penny-in-the-Slot" Meters.

THE main improvements in regard to gas of late years have been principally, indeed almost exclusively, in connection with burners. This need scarcely cause surprise. The apparatus for the manufacture of gas had been brought to a very perfect condition, while in the method of distribution no improvement upon mains and pipes is likely to be devised. In respect to burners, however, a notable advance has been made in recent years, and there is a prospect of even further improvement. The original idea of the burner appears to have been simply an orifice from which the gas could issue, with a slotted plug inserted in the pipe to act as a tap to turn it off and on. "Fish-tail" and "bat's-wing" burners were scarcely more than this. In the "Argand," however, a really scientific and sensible improvement was made, and to this we have already referred in another portion of the book.

Since the first edition of this work appeared, there have been some extensions and modifications of burners which have embodied important advantages. In enumerating these we must again refer to the "Argand" burner as the point of departure in the direction of improvement; indeed the next succeeding step was to modify the Argand for the better. The ingenuity of Messrs. Silber and Sugg discovered and adapted certain improvements in important details. Burners are now constructed so that the gas issues from the nipple at a low pressure, and an air current is compelled, after having traversed channels, to impinge on the flame. In these burners as illustrated by Fig. 122 and Fig. 123—showing a "Silber" and a "Sugg" burner respectively—the details are plainly shown. The orifices for the emission of gas are of considerable size, and in the best class are punctured in a circle of steatite, a material which does not corrode so quickly as iron or other metal. The larger size of the holes in the burner enables the gas to make its exit at as low a pressure as practicable. In both patterns the supply is controlled before reaching the orifices—in the "Silber" by having to pass through small partitions, and in the "Sugg" by being obliged to traverse

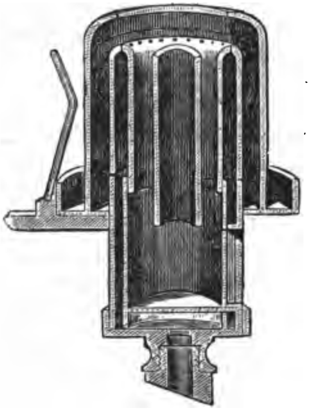


Fig. 122.

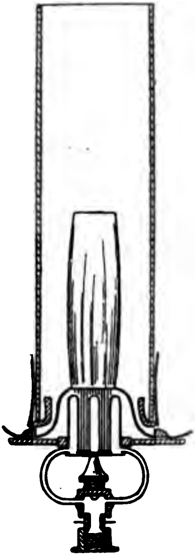


Fig. 123.

small tubes. An additional detail of the "Silber" burner is a central channel for the passage of air to the inside of the flame.

To Mr. W. Sugg, of London, are due the special improvements which have brought the Argand burner up to probably its highest pitch of perfection. The burner made by Sugg in 1869, known as the Sugg-Lethaby, or the "Sugg No. 1," is the standard burner adopted for the United Kingdom, and referred to in Acts of Parliament and municipal bye-laws. The same standard has been adopted in various European countries, the United States, and Canada. Since then, however, further improvements have been made by Mr. Sugg, one of the latest being known as the "London Argand." In order to limit the too abundant flow of gas, and to obviate the rushing or sibilant sound caused by the gas passing a common tap, most argands are now fitted with checks of the nature of a governor, one to each burner. Somewhat analogous, but by no means identical, are regulator burners. These may be classed as "diaphragm," "mercurial," and "float" regulators. A diaphragm regulator is shown in section in Fig. 124. It is provided with a screw fitting in the top to secure adjustment, and to regulate the supply of gas required for each burner. Its operation is simple and obvious. The gas passes through the valve to the chamber below the diaphragm, and passes thence to the burner. At any increase of pressure the diaphragm is raised; this lifts the valve attached, and partially closing it immediately diminishes the supply of gas, which then flows through at

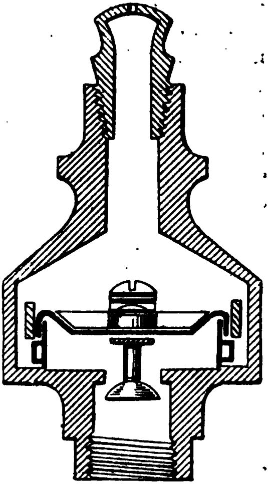


Fig. 124.

a pressure regulated by the weight of the diaphragm and valve.

In the mercurial regulator, in place of the leather diaphragm, there is a mercury seal which controls the supply of gas much in the same way. Float regulators, which act mechanically, consist essentially of perfectly adjusted drums or discs with a valve apparatus working in an outer tube. Although somewhat liable to get out of order from fine particles of dust clogging the working parts, this class of regulator is justly popular, owing to its neatness, inexpensiveness, and general durability.

Various plans for obtaining a greater degree of luminosity or brilliancy of gas by enriching it with volatile vapours have been advocated. This practice is not altogether unknown to gas companies, who, when the candle-power of the gas is poor, enrich it by causing it to pass over receptacles in which naphtha is deposited. The "Albo-carbon" light has now been before the public for some years, and offers undoubted advantages in increasing the luminosity of the flame, and in eliminating the noxious products of combustion which destroy nearly everything brought into contact with them. Here a receptacle is placed near the burner, and this contains a quantity of crystallised mixture which enriches the flame by supplying it with carburetted hydrogen. The reservoir is oval or spherical in shape, and through it the gas travels to the burner, which is placed in such close proximity to the reservoir that the contents are heated and the hydro-carbon vaporised. The light is much more brilliant than that of unenriched gas, and the diffusive nature of the light and its purity are strong recommendations in its favour.

Another modification of burner—if we may so term the improvement—is the type to which the name of "Incandescent" has been applied. The burner itself is "Bunsen," the principle of which is explained at page 44. The three best-known incandescent burners are the "Clamond," the "Welsbach," and the "Lewis," named after their respective inventors. Each has an envelope-mantle, or thimble, which, when heated to a white heat, gives off the light.

In the "Clamond" (Fig. 125), the light itself is enveloped in a compound of magnesia formed into thick threads. It requires a strong concentrated heat to bring the envelope to a state of incandescence. When this is attained, a very brilliant bluish light is emitted.

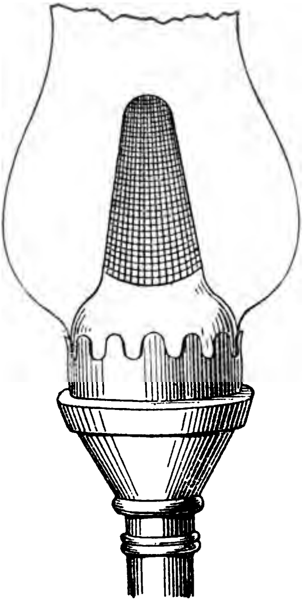


Fig. 125.

The "Welsbach" lamp, or burner, is the invention of Dr. Carl Auer von Welsbach, of Vienna. A mantle is also employed, but it is a cylindrical hood composed of threads of cotton, or similar material, impregnated with a compound liquid composed of solutions of zirconia and oxide of lanthenum. This hood, or mantle, under the influence of the gas flame, becomes converted into a highly refractory material capable of withstanding for long periods without change the highest temperature which can be obtained from an atmospheric burner. It glows with brilliant incandescence, giving a very white and perfectly steady light, bearing not a little resemblance to the electric light. It is claimed that the illuminating power is above 10 candles per cubic foot of gas consumed, and that the fabric of the hood lasts for 800 to 1,000 hours. Fig. 126 shows the lamp, A being the lamp, and B the mantle.

In the "Lewis" light the hood, or envelope, is constructed of platinum, and the light given is reddish-white.

What are known as "regenerative" gas burners, or lamps, have come greatly into use of recent years. They are doubtless very efficient. The principle of the action of these burners is that the gas and air which are to be consumed are raised to a high temperature before combustion. It is claimed that the gas and air so mixed are raised to as great a heat as 900° Fahr. The result of this preparatory heating is an extremely concentrated and brilliant flame.

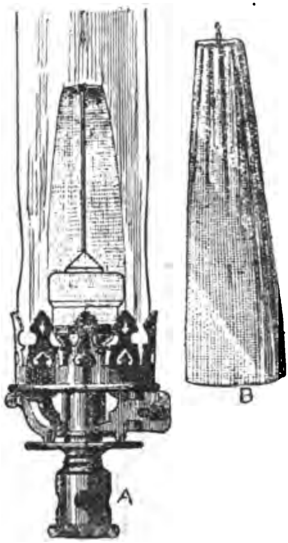


Fig. 126.

The different burners (or rather lamps) on the "regenerative" principle now in the market are all somewhat complex, as the channels through which the gas and air pass to the burner have their walls kept hot by the flame of the burner itself. The "Schalke" lamp was one of the earliest and simplest lights of the type.

The "Siemens" regenerative burner, which has attained great popularity, may be taken as a typical example. One of these is shown in section at Fig. 127, from which its construction will be readily apparent. The direction of the entrance of the air, its circulation around the burner, and exit, is indicated by the small arrows. On igniting the gas at the orifice of the burner, the heat of the flame has to raise the temperature of the upper channels, by which means is initiated that down-draught for the flame which sucks the products of combustion through the metallic body of the burner, and thus brings about the preparatory warming of the entering mixture of gas and air.

The excellent and popular "Wenham" burner acts upon the regenerative principle. As, however, we have already fully described this lamp (pp. 127—130), there is no occasion to go into any details here.

There are various other burners, in which, as in the "Wenham," the heating chamber is arranged above the light, all being, in fact, inverted "Siemens" lamps. Amongst these, we may mention the "Meteor," the "Cromartie" (Sugg's), the "Etoile," Clark's, Chandler's, the "Bower," &c.

We may note that Messrs. Siemens make a burner somewhat different from the one shown in Fig. 127. In this the flame produced is a flat sheet of light, burning horizontally. This lamp is of small dimensions, and does not cast a shadow.

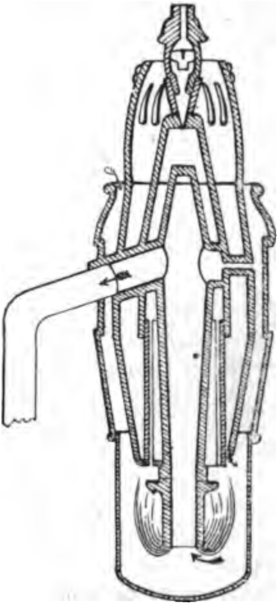


Fig. 127.

The "Douglass" gas burners, made according to Sir James N. Douglass's patent, which have been only recently placed upon the market, appear to have considerable merits. The patentee claims for them that, as the gas is thoroughly consumed, the atmosphere of the rooms where such burners are in use does not suffer vitiation, and neither respiration, nor picture-gilding, nor decorations suffer. Power, purity, and brilliance of flame are secured by thorough combustion, and the entire power of the gas is completely utilised. This burner is shown in section in Fig. 128, where the peculiar form of the chimney may be noted. It is claimed that glass chimneys of this shape cannot be cracked or broken, however suddenly the flame may be turned on, and that draughts do not break them. It is also claimed that the "B" size "Douglass" burner, while consuming 6½ feet of gas per hour, gives as much light as four ordinary burners, each consuming about 5½ feet. That would mean the immense saving of no less than 15½ feet of gas per hour.

A very ingenious and useful burner is Messrs. W. J. Edwards and Co.'s patent "Gas night-light." Fig. 129 shows this apparatus, with the line of wire which passes along the ceiling or wall, between two bell cranks. This can of course be of any required length, and the gas can be turned up or down without rising from bed, thus obviating the inconvenience of groping one's way to bed when the gas is turned out. A touch on the cord will turn the gas full-on, half-on, or leaving the tiniest possible jet. The apparatus will remain in whatever position it may be placed, and additional safety is given by the fact that the light cannot be shut off entirely save by the ordinary tap, so that it is impossible for the light to be turned out, and the gas accidentally turned on again, as sometimes happens

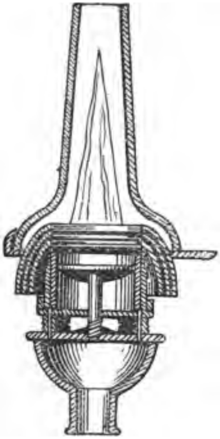


Fig. 128.

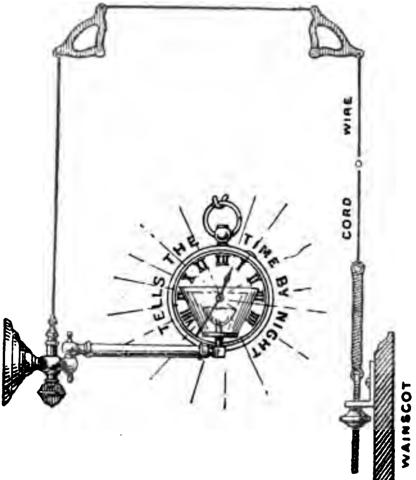

TELLS THE TIME BY NIGHT
WIRE
CORD
WAINSCOT

Fig. 129.

with the ordinary tap. Yet this ingenious appliance does not in the least degree interfere with the use of the tap in the ordinary way, and the comfort and convenience arising from its use is so great that, where once used, it is often continued in use, whether there be any special need for a night-light or not.

A proper glass for chimneys for burners like the "Argand" which require such an appliance, is a matter of some importance, and by no means less so is the selection of gas globes. The size of the upper and lower openings of these latter has a very considerable effect on the gas flame. Too rapid an incoming air-current is prejudicial, and therefore globes with a small bottom aperture, say of only 1¾ inches, should not be adopted. Similarly, globes with a very large top aperture—which allow the heated air to pass out very readily and freely—draw the cold air through the smaller opening below with great velocity, to the detriment of the flame, which is always most steady and effective when the air current which flows around it is constant and uniform. The best kinds of globes, and those most generally in use at the present, are those with large lower apertures, in many instances as large as that at top, 4¼ inches below and 4½ inches above being now very usual. The Gas Committee of the British Association for the Advancement of Science has carefully investigated the subject, and decided that globes of different sizes with 1¾-inch openings produced draughts of varying velocities affecting the light as follows:—a 6-inch globe produced 25 per cent. loss; 7½-inch globe, 27½ per cent. loss; 10½-inch globe, 38 per cent. loss; all these being ground-glass globes. Some 7½-inch clear glass globes were then tried, when those having lower apertures varying from 1½ inches to 2 inches and 2⅜ inches diameter were placed over a flame which (when covered) gave 16·8 candle power. It was found that with an aperture of $2\frac{4}{10}$ inches the flames yielded 15·4 candle power, with 1½ inches aperture 13 candle power, and with 1 inch aperture only 12 candle power. Other experiments also yielded interesting results, which want of space will not permit us to specify.

We may, however, note some of the results arrived at concerning the character of the globe in regard to the interception of light, according to the nature of the medium. The quantity of light intercepted by various species of glass differs greatly. Plain, clear, or colourless glass only absorbs 10 per cent. of light, while ground glass intercepts 25 per cent. and the so-called "opal" glass as much as from 40 to 50 per cent. Coloured glass of course transmits a still less proportion of the light, varying according to the colour. The reader who is curious upon this point is referred to the report of the Committee.

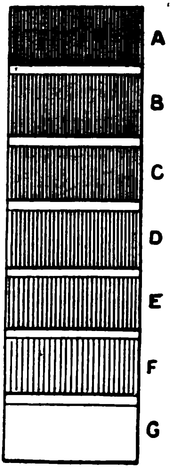


Fig. 130.

In Fig. 130 we adduce a pictorial delineation showing the diminution of light by its passage through the various media specified, as arranged by Mr. Fletcher. Here, G, at the bottom of the diagram, shows the effect of a shadowless open flame; then, gradually ascending, we note how various media intercept more or less of the light; thus, F represents the effects of a polished plate-glass shade; E, that of a clear glass in lamp after one week's use without cleaning; D, ribbed plate; C, rough plate; B, ground glass; and A, opal glass, which naturally intercepts the greater quantity of light.

Having thus briefly spoken of some of the more notable recent improvements in burners, we may now glance at some other novelties in gas appliances which are deserving of mention, first calling attention to some noteworthy circumstances.

Although the illuminating power of electricity had been thoroughly realised for more than half-a-century, it was not until about fifteen years ago that a really practicable economic electric light was introduced. With its introduction, however, a number of sanguine optimistic scientists predicted the certain proximate extinction of gas lighting. According to them, electricity would come in almost immediately, and reign alone. What as a matter of fact has happened?

Unquestionably, both for public and private illuminating purposes, the electric light has been extensively adopted, and is daily coming into wider use; but, for all that, the consumption of gas in our cities and large towns has also increased, and gas companies, instead of being ruined, are paying good dividends. For this state of things there are (at least in our opinion) three principal reasons. First, the letting out by gas companies of efficient cooking and heating apparatus on rent or hire; secondly, the very satisfactory increase of warm bathing amongst us, which has brought into free use "Geysers," "Caldas," and other gas fires for heating baths; and last, but by no means the least, the wide adoption of the "penny-in-the-slot" meter. Many persons will, no doubt, see a fourth reason in the increase in the illuminating power of gas owing to the improvement of burners, and the introduction of incandescent and other modern systems, which have made gas a competitor that need not fear comparison with the electric light.

We have dealt in the foregoing pages with the fixing of cooking and warming stoves, but since this work first appeared great improvements have been made in these appliances. In fact, so numerous are excellent contrivances of the kind that we cannot undertake here to even enumerate them by name. Great credit must, however, be given to Messrs. Wm. Sugg and Co. and Mr. Thos. Fletcher for the attention they have bestowed on gas-heating apparatus and the improvements they have introduced. With regard to the former firm, its "Boiling Steam Therma" is an apparatus of the highest merit, by which 30 gallons of boiling water may be obtained per hour, or a larger quantity up to 120 gallons, at a temperature of not less than 105 degrees, according to the time of the year.

Mr. Thos. Fletcher, of Warrington, deserves also honourable mention for his great improvements upon the "Bunsen" burner for obtaining heat. The merits of the "Bunsen" for heating purposes, as also in cooking, have long been acknowledged. So far back as 1880, the Report of the British Association of Gas Managers noted that "a cooking-stove fitted with the Bunsen burner, formed by a ring of 1¼-inch iron pipe with jet holes 1 inch apart, gave 244 units of heat for each foot of gas." Mr. Fletcher's various heating appliances are based on the "Bunsen" burner which he has so much improved, and which was invented by the celebrated *savant* of that name. As it is employed for heating only, it need not detain us. Its performance depends on the mixture of gas and air. In Wallace's improved Bunsen burner, a perfectly solid flame is obtained of great efficacy for heating purposes in the laboratory.

With regard to the obtaining of hot water for bath purposes, besides Sugg's Boiling Steam Therma (already noticed), many other firms—such as Messrs. Maughan, Ewart, Shrewsbury, &c.—have produced apparatus with more or less fanciful names. Fig. 131 shows Mr. G. Shrewsbury's patent "Calda," wherewith a warm bath can be obtained in a few minutes.

None of the foregoing require special instructions to the gas-fitter, beyond those specified in the manufacturers' prospectuses issued with the goods.

A new feature in gas supply is the Penny-in-the-slot Meter. The "penny-in-the-slot" arrangement originated in connection with the various machines for automatically delivering matches or sweets, and for weighing, which are found in so many public places. The first tentative application of the principle to gas meters was made at Liverpool in 1890, where it soon made rapid progress. During 1891 there were fixed in that city 1,975 meters; in 1892, 4,038; and there are probably over 10,000 now in use. Similar meters have also come widely into use in the metropolis and elsewhere besides Liverpool.

There are several different forms of the meter now in use, all covered by letters patent, and all intended to subserve the same object—viz., to allow a given quantity of gas to pass through on the placing of a coin in a slot provided for the purpose. The meter is usually furnished with three dials, marked £, s., d., respectively, and no sooner has a penny been dropped into the slot than the hand of the d. dial records it. When twelve pennies have been introduced this dial stands at "0," whilst the hand of the s. dial notes "1," and so on, until some pounds' worth of gas are paid for. When all the gas for which the penny is payment has been used, the flame does not at

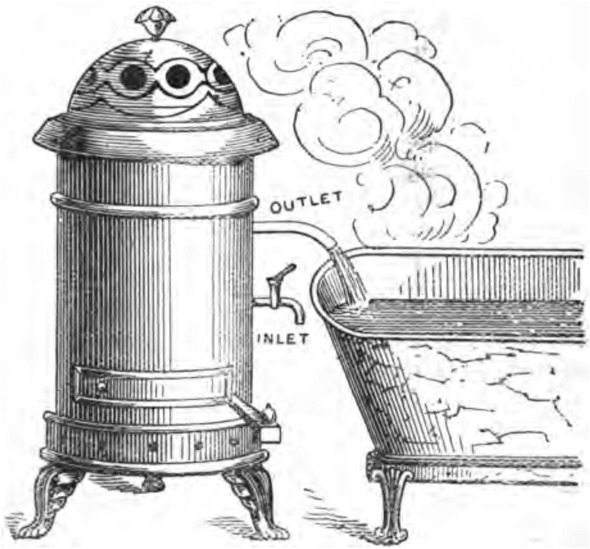


Fig. 181.

once go out; but the consumer is automatically warned that the supply is nearly exhausted by the gradual lowering of the flame.

The mechanism of the various meters for this purpose varies somewhat, but we will take that of Messrs. W. & B. Cowan's meter as an illustration of the mode of action. This apparatus is furnished with a cylindrical pusher which can be actuated backwards and forwards by the movement of a wheel. When a penny is put into the slot, it drops into this pusher, which then, through the intermediation of a pawl, causes a wheel to revolve a certain distance, an index fixed on the axis of the wheel indicating its movement on the dial, and thus recording "1." The apparatus, of whatever maker, is almost invariably attached to dry meters only. There is a valve on the inlet of the meter which gradually closes automatically during the consumption of the last five cubic feet, and thus slowly diminishes the flame, as already mentioned.

Some meters register pennies only; but where the supply goes into shillings and pounds, the arrangement for the second and third dials is carried out by means of wheels with a varying number of teeth.

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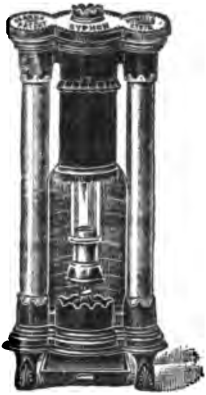

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